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PHYSICAL SIGNS
OF
DISEASES OF THE THORAX
AND
ABDOMEN

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PHYSICAL SIGNS OF DISEASES
OF THE
THORAX AND ABDOMEN

PHYSICAL SIGNS
OF
DISEASES OF THE THORAX
AND
ABDOMEN

BY

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PREFACE

THIS book has been written for medical students, in the hope that in it they will find the help which they especially need in their earlier medical studies.

The physical signs of disease of the thorax and of the abdomen, as ascertained by the six chief methods of examination—viz., by inspection, palpation, mensuration, succussion, percussion, and auscultation—are shortly described. The causes of the physical signs present in health and in disease are discussed, and the usual explanations of them are given. A few, however, of the explanations are my own, while others are those of my former teachers. Differential diagnosis has been carefully considered, and as it concerns certain diseases its chief points have been tabulated. All the illustrations have been drawn by myself, and a few of them are only slightly modified from those already published in various text-books.

JAMES E. H. SAWYER.

BIRMINGHAM,
May, 1908.

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PHYSICAL SIGNS OF DISEASES
OF THE
THORAX AND ABDOMEN

PART I

INTRODUCTORY

CHAPTER I

THE GENERAL ASPECT AND CONDITION OF THE PATIENT

BEFORE making the physical examination which is described in the following chapters, the general aspect and condition of the patient must be observed. From such a preliminary examination much may be learned which will help in the diagnosis of the malady, since many diseases produce general changes which the skilled physician is quick to recognize. It is only by experience that their true value can be estimated, but the knowledge of what to observe must be learned by every medical student. He cannot be expected not to overlook many of the changes which are associated with disease, but by careful study and constant endeavour to develop his faculty of observation he will be surprised how quickly and accurately he will be able to recognize many of the important changes which may occur in the general aspect and condition of the patient.

Attitude.—The attitude of the patient first requires attention. There are many maladies which compel a more or less characteristic attitude to be assumed. For example, when a patient is suffering from pleurisy with effusion, or from pneumonia, he usually lies on the side in which the disease is situated, as in this position breathing is rendered more easy by giving greater freedom of movement to the unaffected side. The pain also may be relieved by this position, which restricts the movements of the inflamed pleural surfaces. If, however, the pain be the chief cause of the position assumed, he may not lie on the affected side, as the pressure sometimes increases the discomfort. Whatever attitude be taken in order to relieve pain, any alteration of position will be resisted by the patient. When dyspnœa is present, the patient is often found propped up in bed, and his distress becomes extreme if the pillows be removed and his head lowered. In heart disease the patient often sits up in bed and leans forward, resting upon a bed-table. The barrel-shaped chest, with rounded shoulders and back bent forward, is very characteristic of pulmonary emphysema. A patient suffering from acute peritonitis lies on his back with the knees drawn up, and is very restless in whatever position he may assume. In any disease which has greatly exhausted the patient's strength, he is seen lying flat on his back, not caring about anything which is going on around him, and making no effort to obtain a comfortable position. All his limbs are flaccid, and he sinks down in the bed. This is especially marked when consciousness has become dulled.

When the patient is standing, notice his attitude, and observe if it be a natural one. He may, for example, bend forward with abdominal pain, or stand with his shoulders thrown back and the abdomen protruding, which position is assumed when a large abdominal tumour or a large amount of ascites is present. The position of the pain will often determine the attitude that is assumed when the patient is standing. One hand may be pressed firmly over the region where the pain is experienced.

The various attitudes which are assumed will be described further when the physical signs of the diseases which produce them are considered. The attitude and gait so characteristic of the various forms of maladies of the nervous system do not come within the scope of this book.

General Condition.—It is of great importance to observe the general condition of the patient. The build, the degree of muscular development, the state of the nutrition, and the amount of subcutaneous fat, must all be noted. The state of the skin should be observed. It may appear quite healthy, or be abnormally pale, or even have an earthy look in certain diseases. There may be jaundice or the lemon tint of pernicious anæmia ; bronzing may be present, as in Addison's disease. General œdema or anasarca may exist, which arises from the accumulation of serous fluid in the subcutaneous connective tissue. The œdema may occur only in the eyelids, as in parenchymatous nephritis. Localized œdema or angioneurotic œdema may be present. Myxœdema may be found, and differs from ordinary œdema in that it does not involve the more dependent parts, and does not show any pitting after pressure with the fingers. In this condition the face and the supraclavicular regions are most affected, the hair falls out, and the skin is dry and harsh to the touch.

Besides observing the attitude and general condition, other changes should be noted in the preliminary examination of the patient.

The Face.—Look first at the patient's face, and notice the expression, for by observing it much of the character of the patient may be read, his general habits of life may be suspected, and the disease from which he is suffering may be indicated. Valuable information, therefore, may be gained from the expression; but, on the other hand, care must be taken, or a false opinion may be formed. It has been truly said: 'It is not the face which deceives; it is we who deceive ourselves in reading in it what is not there.' The expression of the face indicates whether the patient is suffering from pain, and often shows if it has been of long duration. Pain in the head is usually indicated in the upper part of the face by the constant frown; pain in the thorax is shown in the middle of the face, as in the dilated nares in dyspnœa; pain in the abdomen by the lower part of the face, as in the drawn expression of the lips. General wasting is noticeable in the face, and in marked cases is very obvious; but even slight loss of flesh is shown by shrinking in of the temporal regions and undue prominence of the zygomatic processes.

There are special characteristic appearances of the face in certain maladies.

In cardiac disease, especially in the severe forms, the face has often a peculiarly restless expression, which is due to the constant dread that something is going to happen. During an attack of angina pectoris, the face assumes an agonized expression, not only on account of the severe pain which is experienced, but also from the fear of impending death. The face is set rigid, the eyes staring, beads of perspiration appear on the forehead, and an awful horror is depicted in every lineament. In mitral disease, the face often has a healthy appearance, but when compensation has begun to fail the face may be swollen and pale, while the lips and cheeks are livid or cyanosed. In aortic disease extreme pallor is very characteristic. In congenital heart disease the lips and cheeks are often of a bluish tint, and to this the term *morbus cæruleus* has been applied.

In diseases of the lungs or respiratory passages, when the respirations are accelerated, the alæ nasi show undue mobility; this is well seen in a case of pneumonia. In chronic bronchitis and emphysema the lips and cheeks have a bluish tinge. The cyanosis may be marked, while the patient feels fairly comfortable and able to get about. In dyspnœa of inspiratory origin, as occurs in diphtheritic laryngitis, œdema of the glottis, paralysis of the posterior crico-arytenoid muscles, laryngismus stridulus, etc., we find the head thrown back, the nostrils wide, the eyes staring, the mouth half open, and the lips cyanosed. Stridor is associated with this form of dyspnœa. In dyspnœa of expiratory origin, as in pulmonary emphysema and bronchial asthma, the patient's face is often swollen, the conjunctivæ injected, the alæ nasi working vigorously, and the mouth open.

In typhoid fever and other adynamic conditions, the patient lies on his back, and takes no interest in his surroundings. The face is emaciated, dull, and expressionless, the eyes half closed, and the pupils dilated. The lips are drawn, parched, and tremulous, and showing between them the teeth, which are covered with sordes.

In acute peritonitis, the face wears an anxious and distressed expression, the skin is pale and dry, and the lips are drawn tight, showing the teeth between them.

In cholera and the epidemic diarrhœa of infants in the stage of collapse, the face is emaciated, the skin pale, dry, and wrinkled, the eyes sunken and appearing abnormally large.

The *facies Hippocratica* is the name given to the appearance of the face in the acute collapse which is associated with a fatal prognosis. 'A sharp nose, hollow eyes, collapsed temples; the ears cold, contracted, and their lobes turned out; the skin about the forehead rough, distended, and parched; the colour of the whole face green, black, livid, or lead-coloured.'

There are many changes in the face characteristic of disease other than those of the thorax and abdomen. When adenoids are present, the face assumes a dull and stupid expression; the mouth is habitually kept open, as the passage through the nose is obstructed. The alterations in the face due to facial paralysis, bulbar paralysis, paralysis agitans, wry neck, myxœdema, acromegaly, osteitis deformans, congenital syphilis, etc., do not come into the province of this book.

The Eyes.—The prominence of the eyes in exophthalmic goître, their sunken condition in profound collapse, the bluish tint and glistening appearance of the sclerotics in chlorosis, their yellow discoloration in jaundice, and the arcus senilis which indicates early degenerative changes, may be noticed during the preliminary observation of the patient. Puffiness of the lower eyelids, especially in the mornings, occurs in patients suffering from parenchymatous nephritis, and sometimes after paroxysms of coughing.

The nose may show changes in disease, not due to local conditions. The tip may be red in mitral disease, in habitual drunkards, and in chronic indigestion. The mobility of the alæ nasi during respiration should be observed, especially in children.

The lips are often thick in adenoids, and sometimes in phthisis. They may be unduly red in mitral regurgitation, of bluish tint in cyanosis from cardiac or pulmonary disease, pale in chlorosis and other forms of anæmia. Herpes near the lips is very often associated with pneumonia.

The cheeks are pale under many conditions, but chlorosis, parenchymatous nephritis, and aortic regurgitation are nearly always associated with pallor. In fever they are flushed and high-coloured, while in plethora they are rubicund, due to the stagnation of the blood in the smaller veins. The cheeks are affected by exposure, in habitual drunkards, and in chronic indigestion. Lividity or duskiness of the cheeks, in which they have a bluish or cyanotic tint, is found in dyspnœa, either dependent upon diseases of the lungs and pleuræ, obstruction of the air-passages, or diseases of the heart, which may be congenital or associated with failure of compensation. Cyanosis is marked in pulmonary emphysema and congenital heart disease, and may be present to an extreme degree without much embarrassment to the patient, while in the latter disease it may be present without any dyspnœa. It occurs also in large pleuritic effusions, pneumothorax, and extensive disease of the lungs, such as pneumonia and phthisical excavations. There is often a unilateral flushing in pneumonia, the cheek corresponding to the affected side being flushed.

In *the ears* tophi may be noticed in persons suffering from gout. Hæmatoma auris and badly developed ears are often found in the insane.

The Neck.—Abnormalities in the size, length, and shape of the neck, rigidity or drawing to one side, enlargement of the lymphatic glands, swelling of the thyroid glands, and pulsations of the large vessels, etc., may be noticed in the preliminary survey of the patient, and must be carefully examined later.

Abnormal Respiratory Sounds.—The character of the respiration and any abnormal sounds produced in connexion with it should be observed. The character of the respiration will be described hereafter. The abnormal sounds which are heard, apart from those discovered by examination with the stethoscope, are of considerable importance. Most of these sounds are due to obstruction of the respiratory air-passages. Noisy breathing occurs under such conditions. When obstruction is present in the nose from thickening of the mucous membrane or the accumulation of secretions, snuffling, sniffing, or bubbling sounds are produced, and when there are adenoids the patient may snore loudly during sleep. *Stertor* is a snoring sound due to paralysis of the soft palate, and is produced during expiration. There are two forms : (1) Nasal stertor, in which the soft palate flaps against the posterior wall of the pharynx ; and (2) oral stertor, in which the soft palate strikes the tongue, which has fallen back. *Stridor* is due to obstruction, and is produced in the larynx or trachea. The sound almost invariably occurs during inspiration. When, however, tracheal obstruction is present, such as results from the pressure of a mediastinal tumour or aneurysm, the stridor may take place both during inspiration and expiration, and the sound produced has been termed the *leopard growl* by Professor Wyllie. A rattling sound is heard when there is an accumulation of mucus in the trachea, and becomes excessive just before death takes place, when no effort at expiration is made. This is spoken of as the *death-rattle*. When obstruction is present in the bronchi, *wheezing* and crackling sounds may be heard.

Cough.—Cough is produced by the closure of the glottis after a moderately deep inspiration, followed by a sudden and forcible expiration, which opens the glottis in an explosive manner. It varies under different circumstances. Each cough may be separate, or there may be paroxysms of coughing with quiescent intervals of varying length. The cough may be short and dry in the early stages of inflammation of the respiratory mucous membrane, but later, paroxysms of cough occur until the mucus is expectorated. Whenever the secretion is abundant in amount or tenacious in character, lengthy bouts of coughing are necessary in order to remove it. In severe fits of coughing, vomiting may occur at the end of the paroxysm. In whooping-cough there is a series of coughs, made up of short, sharp expiratory acts, which follow each other in rapid succession, terminating in a long-drawn inspiratory act, which sounds like crowing and constitutes the 'whoop.' Vomiting is often induced at the same time. In pleurisy and in pneumonia the cough is single and short, but repeated at frequent intervals. The cough is suppressed as much as possible, and not completed, in order to avoid the pain which the act necessarily gives. The suppression of the cough is found in other conditions where the act of coughing gives pain—*e.g.*, pleurodynia, pericarditis, peritonitis, and surgical affections of the thoracic wall. The brassy cough has a peculiarly hard and metallic ring, and when once heard can never be mistaken. It is characteristic of obstruction of the trachea by pressure from without, as by a mediastinal growth, but especially by an aneurysm. The nervous cough is short, dry, and single, being repeated at frequent intervals. In hysteria the cough is loud and barking, and often seems to be produced in order to attract attention.

CHAPTER II

TOPOGRAPHICAL ANATOMY OF THE THORAX AND ABDOMEN

Regions of the Thorax.—The thoracic wall is divided for the purpose of description into definite areas by means of horizontal structures, such as the ribs and costal cartilages, and by means of various vertical lines. To find any particular rib, it is best to commence to count from the second rib. The cartilage of the second rib joins the sternum at the junction of the manubrium and gladiolus, and this junction can be felt as a definite ridge. The vertical lines are the right and left margins of the sternum; the right and left mammary lines, each passing vertically downwards from the middle of the clavicle; the right and left anterior, middle, and posterior axillary lines, each passing vertically downwards from the anterior fold, apex, and posterior fold, of the axilla respectively; and the right and left scapular lines, each passing vertically through the inferior angle of the scapula.

Besides these areas defined by horizontal and vertical lines, the chest is also divided into three sets of regions: anterior, lateral, and posterior.

The anterior surface of the chest is divided by means of the right and left margins of the sternum into right, median, and left portions, which are subdivided into the following regions:

Right.	*Median.*	*Left.*
Supra-clavicular	Supra-sternal notch	Supra-clavicular
Clavicular	—	Clavicular
Infra-clavicular	Upper sternal region	Infra-clavicular
Mammary	—	Mammary
Infra-mammary	Lower sternal region	Infra-mammary

The clavicular region corresponds to the inner half of the clavicle. The upper and lower sternal regions are divided by a horizontal line at the level of the lower border of the third costal cartilages.

The lateral regions are the axillary and infra-axillary.

The posterior surface of the chest is divided into the following regions:

Right.	*Median.*	*Left.*
Supra-scapular	—	Supra-scapular
Supra-spinous	Inter-scapular	Supra-spinous
Infra-spinous	(on each side of spine)	Infra-spinous
Infra-scapular	—	Infra-scapular

The inter-scapular region occupies the space lying between the inner edge of the scapula and the spinous processes of the dorsal vertebræ. The names of all the other regions explain their position on the thoracic wall.

The Lungs.—The anterior margins of the lungs meet behind the sternum on a level with the lower portion of the first costal space. The anterior margin of the right lung passes vertically downwards behind the sternum, slightly to the left of the middle line, to the level of the sixth costal cartilage. The anterior margin of the left lung diverges from the right at the level of the fourth costal cartilages, sometimes lower than this; it then runs to the left obliquely outwards and downwards, and, curving inwards again, reaches a point about 1 inch internal to the left mammary line on the sixth rib. The lower margin of the right lung passes to the right behind the costal cartilages of the sixth rib, and is at the level of the sixth rib in the mammary line, the eighth rib in the mid-axillary line, and the tenth rib in the scapular line. It reaches the spinal column on a level with the eleventh dorsal vertebra. The inferior margin of the left lung takes a similar course, but extends about a finger's breadth lower than on the right side. The apex of the lung rises on each side to a point about 1½ to 2 inches above the clavicle, and the apex of the right

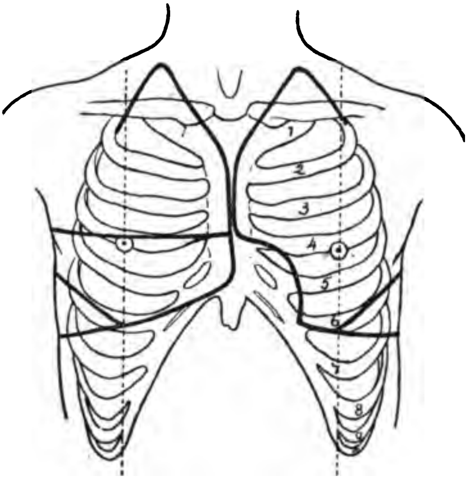

FIG. 1.—SURFACE MARKINGS OF THE LUNGS, IN FRONT.

lung is slightly higher than that of the left side. The external margin of the apex of each lung lies behind the clavicle, just to the outer side of its centre.

The Lobes.—The right lung is divided into three lobes by means of the oblique and transverse fissures ; the left lung into two lobes by means of a similar oblique fissure. The oblique fissure is indicated by a line passing obliquely round the chest from the spinous process of the second dorsal vertebra to the sixth rib in the mammary line. [The most prominent spinous process is that of the seventh cervical vertebra.] When the hand of the patient is placed upon his head, the vertebral border of the scapula corresponds fairly accurately to the oblique fissure. The transverse fissure of the right lung is indicated by a line passing from the point on the oblique fissure where it is crossed by the mid-axillary

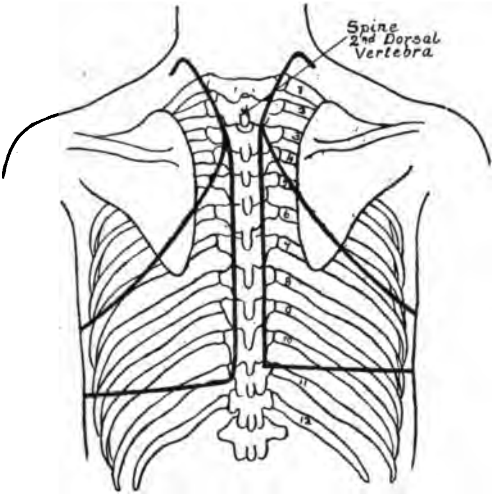

FIG. 2.—SURFACE MARKINGS OF THE LUNGS, BEHIND.

line, to the middle line of the sternum at the level of the fourth costal cartilage.

The Heart.—The heart is situated in the lower part of the mediastinum, and lies obliquely in the thorax. The base is directed upwards, backwards, and to the right; while the apex is directed downwards, forwards, and towards the left. The base is the most fixed point, and is formed by the right auricle, the conus arteriosus, and the appendix of the left auricle. The base of the heart corresponds anteriorly to a line drawn across the sternum on a level with the upper border of the third costal cartilages, and it extends about ½ inch external to each sternal margin. The right border of the heart, which is formed by the right auricle, corresponds to a line from the upper margin of the third right costal cartilage, about ½ inch to the right of the sternum, to the sixth right chondro-sternal junction. The left border of the heart, which is formed by the left ventricle, corresponds to a curved line, with its convexity to the left, extending from the upper margin of the third left costal cartilage to the apex. The apex lies behind the fifth left intercostal space, just internal to the mammary line; but the impulse of the apex, or the apex beat or impulse beat, is felt during life in the fifth left intercostal space, 1 inch internal to the mammary line. The lower border of the heart, which is formed chiefly by the right ventricle, but also by the left ventricle at the apex, corresponds to a line drawn from the sixth right chrondo-sternal junction to the apex. The right ventricle lies in front of the right two-thirds of the left ventricle. The heart lies behind the lower two-thirds of the sternum, the cartilages of the third, fourth, and fifth right ribs, near the sternum, and behind the cartilages of the third, fourth, fifth, and sixth left ribs, extending to the left from 3 to 3½ inches beyond the middle line.

The area thus marked out is called the *præcordia*, and shows the relations of the heart to the anterior chest wall. It is considerably larger than the area of the heart, which is uncovered by the lungs, and which is in contact with the chest wall. The portion of the heart uncovered by the lungs is entirely composed of the right ventricle.

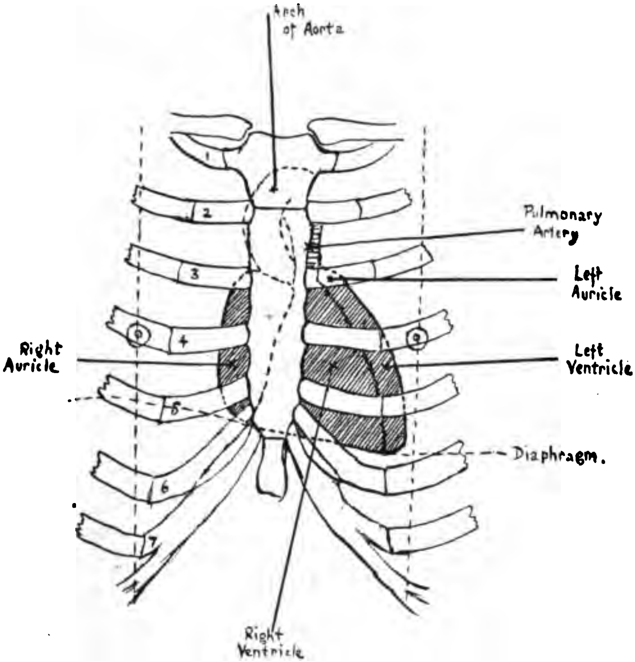

FIG. 3.—RELATION OF HEART TO THE ANTERIOR CHEST WALL.

It must be remembered that the internal mammary artery on the left side descends behind the costal cartilages parallel to and about ½ inch from the margin of the sternum.

Position of the Cardiac Orifices.—The pulmonary orifice lies behind the junction of the upper border of the third left costal cartilage with the sternum. It is placed horizontally, and half is behind the sternum and half behind the costal cartilage. The aortic orifice lies behind the sternum somewhat obliquely, extending from the middle line of the sternum to the third left costal cartilage. It is a little below, behind, and to the right of the pulmonary orifice. The mitral opening is situated below and also behind the aortic orifice. A line representing it extends from the third left intercostal space about ⅓ inch from the sternum to just inside the left sternal margin opposite the fourth left intercostal space.

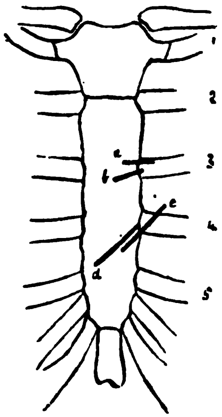

FIG. 4.—RELATION OF CARDIAC ORIFICES TO THE ANTERIOR CHEST WALL.

a, Pulmonary orifice. *b*, Aortic orifice. *c*, Mitral orifice. *d*, Tricuspid orifice.

The tricuspid orifice lies entirely behind the sternum, and a line representing it extends from the fourth left costo-sternal articulation to the right half of the sternum, half-way between the middle line of the sternum and the fifth right costo-sternal articulation. The tricuspid orifice is placed obliquely, its auricular aspect looking backwards, upwards, and to the right. It is situated to the right and in an anterior plane to the mitral orifice.*

The Great Vessels.—The aorta springs from the left ventricle behind the sternum at the level of the third costal cartilages, just to the left of the middle line. The ascending portion of the arch of the aorta runs obliquely upwards to the right, and approaches the surface of the chest most closely at the upper border of the second right costal cartilage, close to the sternum. The transverse portion of the arch is situated in front of the trachea, a little above its bifurcation, and lies behind the centre of the sternum on a level with the first intercostal spaces. It passes backwards, and reaches the left side of the vertebral column between the second and third dorsal vertebræ. From the transverse portion of the arch spring the innominate artery, the left common carotid artery, and the left subclavian artery, and along its upper border lies the left innominate vein.

The pulmonary artery springs from the right ventricle behind the upper portion of the articulation of the third left costal cartilage with the sternum. It passes upwards, backwards, and slightly to the left, on the left side of the ascending portion of the arch of the aorta. The left margin of the sternum divides the artery longitudinally, so that half lies behind the sternum, and the other half behind the second left intercostal space. The pulmonary artery divides into two almost equal branches behind the upper border of the second left costal cartilage.

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* This description of the positions of the cardiac orifices is slightly different from that usually accepted, on account of the recent work of Debierre, Looten, Beun, Tramblin, and Lheureux (*Journal de l'Anatomie et de la Physiologie*, 1908, p. 18).

The innominate artery is given off at the point where the arch of the aorta lies nearest to the thoracic wall—namely, at the junction of the second right costal cartilage with the sternum.

Normal Modifications in the Positions of the Heart and Lungs.—The position of the heart is slightly altered by change of posture of the body. This alteration is more marked in children than in adults. In the recumbent position the heart is slightly higher, and when the patient lies on either side there is some lateral shifting. In the infant, on account of the higher position of the diaphragm, the heart is more horizontal, and the apex-beat is situated in the fourth intercostal space. The apex-beat is usually outside the left mammary line until the fourth year, in the mammary line from the fourth to the tenth year, and by the fourteenth year has assumed the same position as in the adult. The heart alters to a small degree its position during respiration, for during inspiration it descends slightly on account of its attachment to the diaphragm through the pericardium. As the sternum and ribs are raised during inspiration, this descent appears greater than it really is. The portion of the heart uncovered by the lungs is lessened at the end of inspiration, and increased at the end of expiration.

The apices of the lungs rise during inspiration, and their excursions during respiration are of some diagnostic value. In inspiration the lungs enlarge in every direction, so that the anterior margins are more closely approximated, and the lower margins descend.

Sometimes all the thoracic viscera are transposed.

Regions of the Abdomen.—The surface of the abdomen is divided into definite areas by means of two vertical and two horizontal lines. The vertical lines pass through the middle of Poupart's ligament on each side. The horizontal lines are—(1) the infra-costal line, which stretches between the lowest points of the tenth costal cartilages, and (2) the bi-iliac line, which is drawn between the highest points of each iliac crest. The abdomen is therefore divided up into nine regions :

Right.	*Median.*	*Left.*
Hypochondriac	Epigastric	Hypochondriac
Lumbar	Umbilical	Lumbar
Iliac	Hypogastric	Iliac

The natural lines on the surface of the abdomen are—(1) the linea alba, in the middle line ; (2) the two lineæ semilunares, each corresponding to the outer border of the rectus abdominis muscle ; and (3) the three lineæ transversæ, of which the lowest is on a level with the umbilicus.

The umbilicus is situated normally opposite the disc between the third and fourth lumbar vertebræ, and about 2 inches above the bi-iliac line.

The Liver.—Most of the liver lies under cover of the ribs, except a portion of the left lobe, which is in contact with the anterior abdominal wall in the epigastric region. The highest point of the liver is the fourth intercostal space in the right mammary line. The lower border passes obliquely downwards from the left costal margin at the level of the eighth costal cartilage, crossing the middle line half-way between the infra-sternal notch and the umbilicus, to the tenth right costal cartilage. The right lung overlaps the right lobe of the liver in front, reaching down to the sixth rib in the mammary line. An elongated projection sometimes springs from the anterior edge of the right lobe of the liver, and lies over the gall-bladder. This linguiform lobe is known as *Riedel's process*. It is sometimes congenital in origin, but it may also be produced by a portion of the liver being drawn out by the weight of a distended gall-bladder.

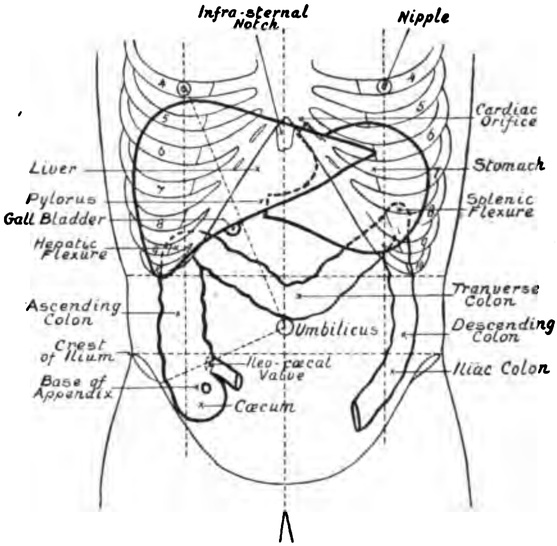


FIG. 5.—RELATION OF SOME OF THE ABDOMINAL VISCERA, AS SEEN FROM THE FRONT.

The fundus of the gall-bladder lies opposite the ninth right costal cartilage, just to the outer side of the right linea semilunaris. A line drawn from the right nipple to the umbilicus just passes to its inner side. This is a rough but useful way of locating the position of the fundus of the gall-bladder.

The Spleen.—The spleen lies obliquely beneath the ninth, tenth, and eleventh ribs, on the left side, and its long axis corresponds to that of the tenth rib. Between it and these ribs are the diaphragm and a small portion of the left lung. The upper end of the spleen is about 1½ inches from the middle line behind on a level with the ninth dorsal spine. The lower end is that part which lies most anteriorly. It rests upon the costo-colic ligament, and reaches as far forward as the mid-axillary line behind the tenth rib. The upper border is on a level with the ninth rib in the scapular line. Its highest and lowest points are on a level respectively with the ninth dorsal and first lumbar spines (Quain).

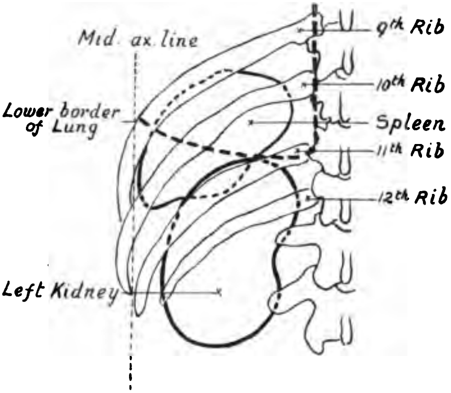


FIG. 6.—THE POSITION OF THE SPLEEN. (AFTER HUGHES AND KEITH.)

The Stomach is situated behind the left hypochondriac and the left half of the epigastric region. The cardiac orifice lies behind the seventh left costal cartilage about 1 inch from the sternum. The pyloric orifice lies 1 inch to the right of the middle line about mid-way between the base of the ensiform cartilage and the umbilicus. The pyloric orifice, however, is not a fixed point. The fundus of the stomach rises to the lower border of the fifth left rib just internal to the mammary line. The position of the greater curvature varies, and in health, with moderate distension, it is usually about the level of the junction of the middle and lower thirds of a line drawn from the base of the ensiform cartilage to the umbilicus. In health it should not reach lower than the umbilicus. When empty, the stomach lies almost entirely under cover of the left lobe of the liver.

The Intestines.—The small intestine is divided into the duodenum, the jejunum, and the ileum. The duodenum commences at the pylorus, and terminates in the jejunum on the left side of the second lumbar vertebra. It is divided into the ascending, descending, and transverse portions. The common bile-duct and the pancreatic duct perforate obliquely the inner side of the descending portion. The jejunum includes the upper two-fifths and the ileum the lower three-fifths of the small intestine, the latter terminating in the right iliac fossa in the commencement of the large intestine. The coils of small intestine lie below the transverse colon, and are covered almost completely by the great omentum. The cæcum lies half in the right iliac region, and half in the hypogastric region, and the ileo-cæcal valve corresponds to the point where a line drawn between the umbilicus and the right anterior superior iliac spine crosses the outer edge of the rectus abdominis muscle. The base of the vermiform appendix is situated rather more than 1 inch below this. The hepatic flexure of the colon lies under the right lobe of the liver behind the ninth and tenth costal cartilages ; the splenic flexure lies behind the stomach in the left hypochondriac region. The ascending colon is placed chiefly in the right iliac and right lumbar regions, but its left border is usually in the umbilical region. The transverse colon, although it may vary considerably in its position, is usually situated in the upper half of the umbilical region. The descending colon lies in the left hypochondriac and lumbar regions, while the iliac colon is in the left iliac and hypogastric regions.

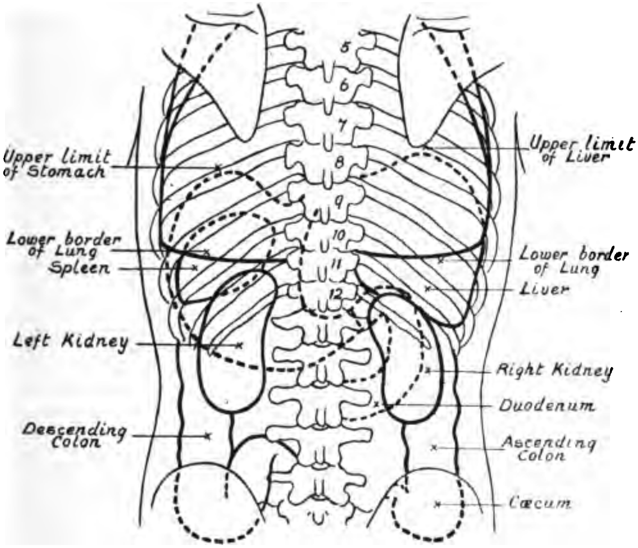


FIG. 7.—RELATION OF VISCERA OF ABDOMEN, AS SEEN FROM BEHIND.

The Kidneys are situated at the back part of the abdominal cavity. The axes of the kidneys are oblique, the upper ends being nearer the spinal column than the lower. A horizontal line through the umbilicus is below the lower edge of each kidney. Posteriorly, about one-third of the left kidney, and not more than one-sixth of the right kidney, lie above the last rib. The upper end of the left kidney is on a level with the spine of the eleventh dorsal vertebra, and its lower end about 2 inches above the iliac crest. The right kidney is from ¼ to ½ inch lower. The hilum of each kidney is placed about 2 inches from the middle line on a level with the spine of the first lumbar vertebra. Congenital abnormalities in the position and shape of the kidneys are sometimes found. As the kidney is developed from the dorsal aspect of the Wolffian duct, near the cloaca, it sometimes, though rarely, remains in the pelvis

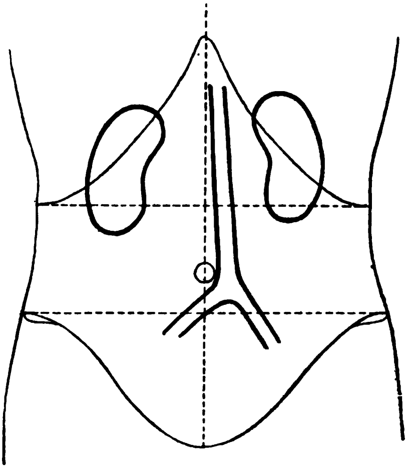


FIG. 8.—RELATION OF KIDNEYS AND AORTA TO ANTERIOR ABDOMINAL WALL.

between the bladder and rectum. It may be found anywhere between this position and its normal bed. Fusion of the two kidneys may occur, giving rise to a solitary kidney, abnormal in shape, the most common form of which is the horseshoe kidney.

The Pancreas crosses the vertebral column opposite the disc between the first and second lumbar vertebræ, which corresponds to a point mid-way between the base of the ensiform cartilage and the umbilicus. It lies slightly obliquely across the back part of the abdomen, the head being a little lower than the tail. About one-third of the length of the pancreas is to the right of the middle line.

The Urinary Bladder does not appear above the pubes unless it be distended. It may, however, reach as high as the umbilicus.

The Abdominal Aorta can be fairly accurately marked out on the surface of the abdomen by a line drawn from the middle line of the body, on a level with the seventh costal cartilage, to a point ½ inch below and to the left of the umbilicus, where the bifurcation of the aorta occurs.

PART II

EXAMINATION OF THE THORAX

CHAPTER I

INSPECTION OF THE THORAX

On inspection of the thorax, the following points may be observed :

- A. Form of the chest.
  - 1. In health.
  - 2. In disease.
    - (1) Deformities.
    - (2) General changes.
    - (3) Local changes.
- B. Movements of the chest.
  - 1. Movements of respiration.
    - (1) Frequency.
    - (2) Rhythm.
    - (3) Extent.
    - (4) Dyspnœa.
    - (5) Orthopnœa.
  - 2. Pulsations.
- C. Dilated veins and venules.

In order to inspect the thorax, its surface must be fully exposed, and the patient should be placed in a good light.

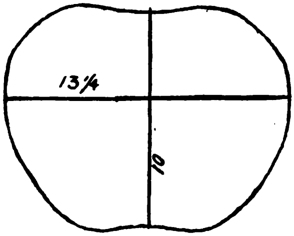
Many errors are made from the chest not being fully bared.

The anterior surface of the chest should be inspected first, and this should be done by the observer standing exactly in front of the patient. It is extremely important that the two sides of the chest be compared as to their size, shape, and movements. This observation can be made from in front, but should also be made by inspection from above. If the observer stand behind the patient, and look down over the shoulders, he will very easily detect differences in the shape or movements of the two sides of the upper part of the anterior wall of the thorax. On inspection in this position, three outlines will appear on each side. The first is the outline of the side of the neck and the upper part of the shoulder, the second is the prominence of the clavicle, and the third the prominence of the chest wall in front. All these must be compared on the two sides for differences in their relation to each other. For example, if the outlines of the clavicle and chest wall appear nearer together on one side than the other, then there is probably some falling in of the chest wall on the side where these outlines are nearer. Any flattening of the chest wall will be noticed, and if during inspiration one side begin to move before or expand more than the other, the condition will be at once obvious. Inspection from below is also of great value, and this is performed when the patient is in the recumbent posture, by the examiner going to the foot of the couch or bed and bending down until he is in a convenient position to observe the outline of the chest. Very slight irregularities in the two sides, both of the thorax and abdomen, can be seen from this position. The thorax must also be inspected from behind and from the side. From the latter position slight pulsation of the wall of the chest in front can more easily be discerned, and retraction due to an adherent pericardium is made more obvious.

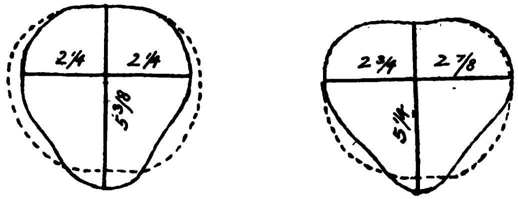
Form of the Healthy Chest.—The healthy chest is conical in form, and the transverse diameter is greater than the antero-posterior. The two sides appear symmetrical, although there are few healthy chests which are quite symmetrical upon measurement. The right side is usually a little more in circumference than the left. The chest is rounded in all its outlines, and there is a slight degree of subclavicular depression, which is more marked in men than women. The nipples are at equal distance from the sternum, and opposite the fourth rib in men. In the upper two-thirds of the chest in front the outlines of the ribs are not noticeable, but below the pectoral muscles they can easily be defined, and the intercostal spaces are slightly hollowed. The angles formed by the costal cartilages with the sternum in front, and by the ribs with the vertebral column behind, should correspond on the two sides. The shoulders are upon the same level, although one may be slightly higher than the other. The scapulæ should be symmetrical. The sternum and vertebral column should appear exactly in the middle line, and the latter preserve the normal dorsal curve. There should be no prominence over the præcordia.

Alterations in the Form of the Chest in Disease.—There are, however, many slight deviations from the typical form of the chest which are not due to disease. A long, narrow chest (*alar chest*), or one flattened anteriorly (*flat chest*), is often seen, and especially are these shapes found in persons predisposed to phthisis. A long neck and sloping shoulders are often associated with this condition, while a short, thick neck with high shoulders is found to occur in persons subject to apoplexy.

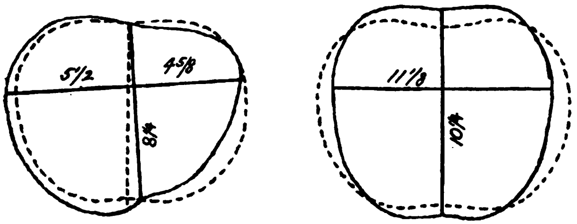
(1) *Deformities.*—The ***rachitic chest*** is produced by the



Normal adult chest.



Rickety chest—child, aged 15 months. Pigeon chest—child, aged 14 months.



Fibrosis of left lung—man, aged 30 years. Emphysematous chest.

FIG. 9.—CYRTOMETRIC TRACINGS OF VARIOUS FORMS OF CHEST.

Transverse sections of various forms of chest at the level of the sterno-xiphoid articulation, reduced from cyrtometric tracings. The dotted lines indicate the natural shape at the same age. The figures represent the measurements in inches.

yielding of the softened ribs in rickets. The yielding occurs chiefly where the bones and costal cartilages meet, so that a vertical groove is formed, and the chest on transverse section is somewhat quadrilateral or pear-shaped (Fig. 9). It has also been suggested that these vertical grooves may be formed partly by the pressure of the child's arms against the softened ribs. There is usually enlargement or 'beading' of the sternal ends of the ribs, giving rise to the *rickety rosary*. This may be seen on inspection, but is usually better felt. The *pigeon chest* is also produced by the yielding of the ribs in rickets in such a way that the sternum becomes prominent and the ribs flattened. On transverse section the chest appears triangular, and is often not quite symmetrical (Fig. 9). *Harrison's sulcus* is a horizontal groove in the lower part of the chest, which occurs in infants suffering from rickets, and which is due to the sinking in of the ribs above the attachment of the diaphragm. This groove is exaggerated through the lower ribs being pushed out by the increase in size of the abdominal viscera. Other deformities of the chest may occur due to rickets.

Spinal curvatures also produce great alterations in the form of the thorax. Deformities occur, therefore, as a result of scoliosis and kyphosis.

(2) *General Changes.*—The loss of fat and the wasting of the muscles of the thoracic walls will be noticed as a part of the general condition of the patient.

In pulmonary emphysema the chest is *barrel-shaped*, and enlarged in all directions, so that it gives the appearance which is assumed after deep inspiration. The shoulders are higher than in health, and the intercostal spaces are enlarged and bulging, while the dorsal curve of the spine is exaggerated. A *unilateral enlargement* of the chest may occur in pleurisy, with extensive effusion, in pneumothorax, and when a tumour affects the greater part of one lung or pleura. In all these conditions the heart is displaced towards the sound side. When one lung has been collapsed for some considerable time, or is not performing its functions on account of disease, the other lung may become enlarged and emphysematous, producing a unilateral enlargement of the chest. *Unilateral shrinking* may occur after the absorption of a large pleuritic effusion, and especially after an empyema, when the lung has failed to expand. A similar shrinking occurs in fibrosis of one lung. In these conditions the heart is displaced towards the affected side.

(3) *Local Changes.—Bulging* of the chest wall may occur in pleuritic effusions, either serous or purulent. Sometimes a bulging is found in an empyema, produced by the abscess pointing externally. In emphysema bulging may be present in the supra-clavicular and infra-clavicular regions. Bulging may also be due to an intra-thoracic tumour, or to an aneurysm of the arch of the aorta. The præcordia becomes prominent in children in cases of pericardial effusion, or when the heart is enlarged. The bulging in these cases is sometimes very marked. An enlargement of the liver may also cause a prominence of the ribs under which it lies. A similar condition may be produced by an enlarged spleen, and sometimes by a large tumour of the left kidney.

Retraction of the chest is a local shrinking, and may occur in any condition in which there is a portion of the lung contracted by disease. This is often seen over one or both apices of the lungs in cases of phthisis. It is also found in fibroid conditions of the lungs which are not tuberculous. After the absorption of a large pleuritic effusion or the removal of the pus from an empyema, the lung sometimes is unable to expand, and a falling-in of the chest wall may occur in consequence.

Movements of the Healthy Chest.—Respiration is considered normal when the anterior and lateral parts of the chest dilate equally, distinctly, yet moderately, during inspiration (Laennec). The capacity of the chest is increased during inspiration by the clavicles, ribs, and sternum being raised and the dome of the diaphragm lowered. The upper ribs converge as they are raised, while the lower ones diverge. The costal margins move apart so as to widen the epigastrium. The result is that the chest is raised, widened, and deepened. The reverse occurs during expiration. In normal respiration there is no distinct interval between inspiration and expiration; the one seems to flow on into the other. Inspiration and expiration are roughly equal in length, although the former is usually slightly shorter than the latter. The rate of respiration is from sixteen to twenty times per minute in the adult, or about one to every four beats of the heart. It is important to notice the ratio between the number of respirations and the frequency of the pulse. This should be 1 to 4, but in disease it may vary greatly. In new-born children the respirations are about forty per minute.

The manner in which the movements of respiration are performed differs according to age and in the two sexes. In young children there is very little movement of the thoracic wall, and respiration depends chiefly on the action of the diaphragm. This form of respiration is spoken of as abdominal, and in it the movements of the abdomen are very pronounced. In men respiration approaches more to the abdominal type, for inspiration depends chiefly on the action of the diaphragm and the expansion of the lower part of the chest. In women the movements of the upper part of the chest are very much more marked than in men, while those of the lower part of the chest and diaphragm are not nearly so pronounced.

Movements of the Chest in Disease—(1) *Frequency.*—The frequency of respiration varies under many circumstances. Its rate is altered by different postures of the patient, by sleep, exertion, and exhaustion, and during speaking, coughing, swallowing, and mental agitation. In febrile states respiration is usually quicker, but as long as this acceleration corresponds to that of the pulse, giving a ratio of about 1 to 4, the increased frequency of respiration may be considered to be due purely to the febrile condition. When the respirations become quicker than in this proportion, then there is usually some respiratory disorder causing it. Respiration becomes more frequent in almost every form of disease of the respiratory organs, and this acceleration constitutes one of the features of nearly every variety of dyspnœa. Under the heading of dyspnœa the causes of more rapid respiration will be classified. Increased frequency of respiration is present in almost every malady causing wasting and exhaustion, and is found in the debilitated conditions occurring during the convalescence of many diseases. It is also found in various forms of anæmia, in exophthalmic goître, and after the administration of certain drugs. Increased frequency of the respirations may occur without dyspnœa or difficulty in breathing, but any additional exertion will show that the breathing is being carried on almost at the limit of the patient's powers. Diminished frequency of respiration may be present in any cerebral disease which involves the respiratory centre in the medulla, but more usually, however, such an affection produces an increase in frequency.

(2) *Rhythm.*—Inspiration and expiration are nearly equal in length during health, but if there be obstruction to the entrance of air into the lungs, then the former is increased relatively to the latter. This is well seen in laryngeal obstruction, when inspiration may be accompanied by a loud, harsh sound, which is spoken of as *stridor*. The length of expiration is increased relatively to inspiration whenever there is any impediment to the exit of air from the lungs, caused either by obstruction in the air-passages or by diminished elasticity of the lungs. In pulmonary emphysema the shallow breathing with this prolongation of expiration is well seen. Jerky and unequal depths of respiration are frequently found in persons suffering from pulmonary consumption, in any marked degree of debility, and in young children. Changes in rhythm occur in cardiac disease, especially when a dilated and fatty heart is present, and these changes consist in a few quick gasps followed by a period of slow and shallow respiration. This is called *sighing respiration*. A marked degree of this is spoken of as *Cheyne-Stokes respiration*, which, to quote the words of Stokes, 'consists in the occurrence of a series of inspirations increasing to a maximum, and then declining in force and length until a state of apparent apnœa is established. In this condition the patient may remain for such a length of time as to make his attendants believe that he is dead, when a low inspiration, followed by one more decided, marks the commencement of a new ascending and then descending series of inspirations.' A most interesting point is the periodic occurrence of the phenomenon. Cheyne-

Stokes respiration is known to occur in uræmia, in diseases of the heart, in diseases of the brain, especially of the medulla, of the lungs and kidneys, in sunstroke, in typhus, and under the action of narcotics. It has also been observed in apparent health. Slight variations in its character are found, and have given such names as 'cerebral respirations' and 'tidal breathing.' Cheyne-Stokes respiration is considered to be one of the immediate precursors of a fatal termination.

The rhythm of the respiratory movements is also affected in the early and painful stages of pleurisy, as the patient often holds his breath before the end of inspiration on account of the pain. The result is that the thoracic inspiratory movements are cut short, while the abdominal are slightly increased in amount.

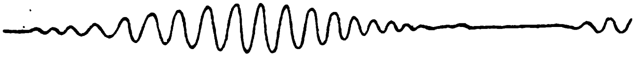


FIG. 10.—CHEYNE-STOKES RESPIRATION.

(3) *Extent of the Respiratory Movements.*—A great diminution in the movements of the chest in every direction accompanies pulmonary emphysema. The thorax is barrel-shaped, and during respiration it seems to move as a whole. There is slight elevation, and practically no expansion. The intercostal hollows do not appear so well marked at the end of inspiration as under healthy conditions.

In those conditions in which the act of respiration causes pain the respiratory movements are restricted. Thus the movements of the chest wall are diminished in the early and painful stages of pleurisy, especially on the affected side, and again in abdominal pain, as in acute general peritonitis, the movements of the lower part of the chest are restricted.

The respiratory movements become excessive when dyspnœa prompts increased muscular effort to overcome some of the embarrassment.

It is most important to observe if there be any portion of the chest wall showing diminished mobility. This portion may be only a small area, or it may be the whole of one side of the chest. When one lung is compressed by the presence of a pleuritic effusion or is unable to expand from any other cause, then there is diminished movement of that side of the chest. Again, in pneumonia and in pneumothorax the side affected does not move so well as the other. When tuberculous consolidation occurs at the apex of one lung, the upper part of the chest does not expand so well on that side as the other, and relatively less than the lower part of the chest on the same side. Wherever a large portion of a lung cannot expand, the remaining portion of that lung and the other lung will expand more than normally. For this reason in a large pleuritic effusion excessive expansion of the chest on the opposite side is found.

When obstruction occurs in the fauces, larynx, or trachea, from disease or from impaction of foreign bodies, a retraction of the lower and lateral parts of the chest and of the lower end of the sternum and epigastrium occurs with inspiration. This is frequently seen in children in cases of diphtheritic laryngitis, and the amount of retraction may be extreme. The elastic chest walls are forced in, so that a deep groove is formed round the lower part of the chest. The hollowness in the supra-sternal and supra-clavicular regions is greatly increased. Similar retraction, though not so marked, occurs in capillary bronchitis.

In paralysis of the diaphragm, the lower part of the chest expands more than normally during inspiration, as the walls are not held together by the contraction of the diaphragm. At the same time a depression appears in the epigastrium, instead of the prominence which usually occurs at the end of inspiration during normal and tranquil breathing. The patient is unable to draw a deep breath, and there is difficulty in coughing up the mucus which may have accumulated in the bronchial tubes.

(4) *Dyspnœa*, or difficulty in breathing, is one of the commonest symptoms which occur in connexion with the respiratory movements. It is usually both inspiratory and expiratory, and is brought about by some interference with the necessary oxygenation of the blood in the pulmonary circulation. This diminished oxygenation may be due to—

(*a*) Less air reaching the pulmonary capillaries than normally.
(*b*) Less blood passing through these capillaries.
(*c*) The capacity of the blood to take up oxygen being reduced.
(*d*) An abnormal requirement of oxygen on account of increased metabolism.

If due oxygenation of the blood do not occur, then *cyanosis*, more or less marked, appears.

Dyspnœa may be *inspiratory*, under which condition the patient experiences difficulty in getting the air into the lungs. This occurs in cases of obstruction of the upper air-passages, and is marked by stridor. On the other hand, the dyspnœa may be *expiratory*, in which there is no trouble with inspiration; the patient has difficulty in emptying the chest of air. This form occurs in pulmonary vesicular emphysema and in spasmodic asthma.

The causes of dyspnœa are—

(i.) Central :

- (*a*) Various poisons, as in uræmia and diabetic coma.
- (*b*) Hysteria, neurasthenia.
- (*c*) Lesions interfering with the respiratory centre.

(ii.) Obstruction of the air-passages :

- (*a*) Nose and pharynx.
- (*b*) Larynx : Inflammations, spasm of glottis, œdema of glottis, foreign bodies, laryngismus stridulus, paralysis of abductors, diphtheritic membranes, tumours, etc.
- (*c*) Trachea : Diphtheritic membranes, pressure from without, tumours, aneurysms, stenosis, foreign bodies.
- (*d*) Bronchi : Accumulation of secretions, pressure from without, fibrinous bronchitis, bronchial asthma, foreign bodies.

(iii.) Diminished lung tissue :

- (*a*) By disease in the lungs : Pneumonia, broncho-pneumonia, phthisis, œdema, passive congestion, fibroid infiltration, emphysema, infarct, collapse of lung, bronchiectasis, gangrene, abscess, tumours.
- (*b*) By disease external to the lungs : Pleuritic effusions, empyema, pneumothorax, tumours, aneurysm.

(iv.) Interference with the respiratory movements :

- (*a*) Pain on respiration, ossification of costal cartilages, paralysis, either diphtheritic or due to affections of the cervical cord.
- (*b*) Pressure from below the diaphragm: Ascites, abdominal tumours.

(v.) Cardiac disease: Diseases of the heart and pericardium.

(vi.) Changes in the blood: Uræmia, anæmia, methæmocythæmia.

(vii.) Excessive muscular exertion.

(5) *Orthopnœa* occurs in dyspnœa, and is the name applied to the condition when the patient assumes the upright posture for the purpose of breathing more easily. It is most usually seen in cardiac dyspnœa, and even when the difficulty in breathing is primarily due to another condition, the orthopnœa, if strongly marked, is nearly always associated with some cardiac failure.

Pulsations.—The cardiac impulse cannot always be seen, but when observed in health it is found in the fifth left intercostal space about 1 inch internal to the mammary line. The cardiac impulse is gentle, rhythmical, and occurs about seventy-five times a minute in the adult male. All abnormal cardiac pulsations will be considered under the head of Palpation, as they should be confirmed by this means of diagnosis (p. 44). An aortic aneurysm frequently gives rise to visible pulsation. If the ascending portion of the arch of the aorta be the part affected, the pulsation is usually observed on the right of the sternum in the second or third intercostal spaces ; if the transverse portion, the pulsation is in the middle line, and may appear in the supra-sternal notch ; but if the descending portion of the arch be affected, the pulsations are rarely seen. Sometimes, however, pulsation is observed in the left inter-scapular region. An aneurysm of the ascending portion of the arch of the aorta may be so large that its pulsations can be seen over an extensive area of the right side of the chest in front, and also over the upper part of the right side of the chest behind. Aneurysms of the innominate and subclavian arteries may show visible pulsations. A malignant tumour with a large blood-supply may give rise to pulsation, and sometimes pulsation over an empyema may be felt in or near the præcordia.

Epigastric pulsations are described in Part III., Chapter I.

Pulsation of the vessels in the neck will be considered under Palpation of the Thorax.

Dilated Veins and Venules.—Dilated veins may be seen over the chest, and may be the result of—

(1) Some obstruction to the return of blood to the heart, and so the formation of collateral channels. The obstruction may be caused by an intrathoracic tumour. Portal obstruction, or any other impediment to the return of blood from the abdominal viscera or from the lower limbs, may cause dilated veins in the abdominal and thoracic walls. The direction of the blood-flow should be noted in the dilated veins.

(2) Dilated veins may also be found when the right side of the heart is engorged, but are often present when such a condition does not seem to exist. A row of dilated venules frequently appears like a belt at the level of the attachment of the diaphragm.

(3) Veins in the thoracic walls are often conspicuous, especially in children, without there being any venous obstruction, when the skin is unusually pale and transparent.

CHAPTER II

PALPATION OF THE THORAX

PALPATION, the application of the hand to the external surface, is a mode of examination which is a very important adjunct to inspection, and which is capable of giving much information in diseases of the chest. By its means can be determined the form and movements of the thorax, the presence or absence of fremitus and fluctuations, and the position, character, and extent of the impulse of the heart. Palpitation and cardiac thrills can be felt.

Method.—In palpation the palmar surface of the hand must be placed flat and evenly upon the chest wall. It is very important that the hands should be warm. Pulsations, thrills, and fremitus can more easily be felt by the fingers than by the palm of the hand. By placing the hands symmetrically upon the sides of the chest, any inequality in the movements of the two sides can be easily felt; and if the hands are placed over the lower part of the chest, with the thumbs towards the sternum, the extent of the respiratory movements can be estimated by the approach and separation of the thumbs. By standing behind the patient and placing the hands over the apices of the lungs, the fingers resting over the clavicles and the upper part of the chest in front, with the thumbs meeting behind the neck, differences in the expansion of the two sides can be easily appreciated. Palpation will determine undue or diminished movement in any part of the chest wall. The condition of the intercostal spaces, whether bulging, resistant, retracted, or widened, can be determined. The rate of respiration may be counted by placing the hand on the chest wall. In palpating the præcordia, the hand should first be placed flat and evenly over it, so that the character of the impulse and any thrills may be noticed. The position of the apex-beat can best be determined by palpation with the tips of the fingers.

Examination of the Heart by Palpation.—The hand should be placed horizontally across the præcordia, so that the tips of the fingers reach to the left anterior axillary line. The impulse of the heart, which corresponds with the first part of the systole of the ventricles, and which is synchronous with the first sound, can be felt and its strength estimated. It is best to determine first the position of the apex-beat, not only in examining the heart, but also as the first object to ascertain on palpation of the chest. Its position gives very valuable information, not only in diseases of the heart, but also in those of the lungs.

1. *Position of the Apex-Beat.*—The apex-beat is the lowest and outermost point at which the cardiac impulse can be felt, and in the normal adult chest it is situated in the fifth left intercostal space, 1 inch internal to the mammary line. It may be impossible to define the position of the apex-beat even in health, on account of increased thickness of the chest wall, either due to muscular development or to an excess of fat, and also in the female on account of a large mamma. A similar difficulty arises when the cardiac impulse is feeble, when

the heart is overlapped by the left lung, as in pulmonary emphysema, or when pericardial effusion is present.

The apex-beat may be displaced in many ways. It is raised and displaced slightly to the left by any cause which increases the height of the diaphragm, such as ascites, tympanites, abdominal tumours, and pregnancy. The cardiac impulse is also raised in pericardial effusions, and it may be dragged up in a shrinking of the left lung. The apex-beat is displaced downwards and to the left in hypertrophy of the heart, especially when it affects the left ventricle chiefly. The heart is also displaced to the left in fibrosis of the left lung, in effusions or air in the right pleura, and with large tumours of the right lung. The cardiac impulse may be displaced to the right by fibrosis of the right lung, by effusion in the left pleura, by a left pneumothorax, and by tumours of the left lung.

The apex-beat may be found on the right side in transposition of the heart, and is occasionally drawn over to the right of the sternum in extreme contraction of the right lung. It may also be displaced in deformities of the chest wall as the result of rickets, and especially in the marked deformities due to the various forms of spinal curvature.

2. *Strength of the Apex-Beat.*—The strength of the apex-beat may be increased or diminished in disease, or the impulse may be absent. Its increase in force may be of neurotic origin, or from violent exercise. The chief cause of a heaving impulse is hypertrophy of the left ventricle. The apex-beat may be diminished in strength when the heart is acting feebly, in cardiac dilatation, in adherent pericardium, in pericarditis with effusion, in effusions or with air in the left pleural cavity, and when an emphysematous lung intervenes

between it and the chest wall. The apex-beat may not be felt on account of increased thickness of the chest wall, either due to fat or muscular development. It is usually absent in pericarditis with effusion, and when the cardiac apex is covered up by an emphysematous lung, or by an effusion or air in the left pleural cavity.

3. *Area over which the Cardiac Impulse is felt.*—Normally the cardiac impulse can only be felt over an area about 1 inch square in the left fifth intercostal space. If, however, the chest wall be very thin, a much larger area is often found. The impulse may be diffused over a considerable area in (*a*) increased cardiac action from exertion or excitement, (*b*) in cardiac hypertrophy, and (*c*) in retraction of the left lung, which exposes more of the surface of the heart to the chest wall.

4. *Rhythm.*—The cardiac impulse is regular in time, and each beat is equal in force. The rate is about seventy-five times per minute, but this is variable considerably in health. By palpation any irregularity in the impulse can be detected. There may be complete irregularity both in rate and force, or there may be rhythmic irregularity. Any intermittent action of the heart will also be noticed.

5. *Abnormal Pulsations* have been partly described in the chapter on Inspection of the Thorax, and their presence can be confirmed by palpation. In the examination of abnormal pulsations, a combination of inspection and palpation is usually necessary to ascertain the rhythm of the pulsation. The pulsations should be observed while the tips of the fingers are placed on the apex-beat of the heart. *Systolic retraction*, however, is more easily seen than felt, and is best determined by inspection from the side. It is always due to an adherent pericardium when situated near the apex-beat, but when

elsewhere may be due to other conditions. In thin persons and in children a systolic indrawing of the third and fourth left intercostal spaces close to the sternum is often seen, and is produced by the normal recession of the base of the heart during each ventricular systole. Systolic retraction in the lower part of the præcordia occurs in adherent pericardium; it may also be noticed over the lower sternal region, and even at the ensiform cartilage. This retraction is followed by the *diastolic shock.* Near the position of the cardiac apex a *diastolic retraction* sometimes occurs, immediately following the impulse, and is a pathognomonic sign of adherent pericardium. As the cardiac impulse subsides, a slight indrawing of the chest wall occurs. In the second left intercostal space close to the sternum a pulsation, systolic in rhythm, is often felt, and is communicated from the pulmonary artery when the edge of the left lung is retracted. In rare instances, pulsation of the left auricle may be felt in this region, occurring chiefly in mitral stenosis with hypertrophy of the auricle; the impulse in such a case precedes the apex-beat. Pulsations due to aneurysms have already been described under Inspection, but they can often be detected by palpation, when they cannot be observed by inspection.

6. *Thrills.*—Endocardial thrills are caused by the vibrations produced when the blood is forced through a small opening into a wider space. This occurs in stenosis of any one of the orifices of the heart. A thrill in the region of the apex-beat is usually due to mitral stenosis, and is presystolic in time. A systolic thrill sometimes occurs in incompetence of the mitral valve. A systolic thrill may be felt over the aortic area in aortic stenosis, thickening of the aortic valves, and in atheroma, dilata-

tion, and aneurysm of the ascending portion of the arch of the aorta. A diastolic thrill due to aortic regurgitation is sometimes present. Presystolic and systolic thrills may occur just to the right of the sternum, in the tricuspid area, due to stenosis and incompetence of this valve. Stenosis of the pulmonary artery may also produce a thrill. Thrills due to congenital heart disease may be felt almost anywhere over the præcordia, and are systolic and diastolic in time. A slight thrill is sometimes felt in anæmia over the pulmonary area. The pulsations of an aneurysmal swelling are often accompanied by a thrill.

Pericardial friction-fremitus is produced by the movements of the roughened pericardial surfaces. The friction is more easily detected by auscultation, but when appreciated by palpation it is different from the endocardial thrill in that it has a more rubbing character, while the other is a more purring vibration. It can be distinguished from pleural fremitus by asking the patient to hold his breath.

Examination of the Lungs by Palpation.—1. *Vocal Fremitus* is the vibration which may be felt when the observer's hand is applied to the chest wall while the patient is in the act of speaking. Palpation for vocal fremitus is performed by directing the patient to say ' ninety-nine,' and by applying the palm of the hand evenly to the chest wall. The same hand should always be used in examining the various parts of the chest wall. The intensity of the vibrations are thus estimated, and a comparison between the corresponding sides of the chest is made. The fremitus is deadened if the hand be pressed too firmly on the chest wall. The intensity of the vocal fremitus is increased in proportion to the depth of the pitch and to the loudness of the voice. It is more marked in males than in females, in adults than in children, in subjects with long and narrow chests than in those with short and broad chests, and in thin persons than in fat. The intensity of the fremitus is slightly greater on the right than on the left side, the increase being more marked in the infra-clavicular, infra-scapular, and inter-scapular regions. Vocal fremitus is absent, of course, in the præcordial region.

Vocal fremitus may be increased, diminished, or altogether absent in disease. These changes can be best appreciated by comparing the two sides of the chest.

Vocal fremitus is *increased* when the lung is consolidated, as in pneumonia and tuberculosis, the parts affected becoming a better conductor of the vibrations. It is necessary, however, that the larger bronchial tubes should remain open, or otherwise the fremitus is diminished or absent. The vibration is exaggerated when the bronchial tubes are dilated, particularly when the surrounding lung is more or less consolidated, as in bronchiectasis, and also in tuberculosis when a vomica is present.

Vocal fremitus is *diminished* in intensity or *absent* when the lung is removed from the chest wall by accumulations in the pleural cavity of fluid or of air. Thickening of the pleura, due to previous disease, causes a diminution in the intensity of the fremitus, and also a defective expansion of the lung produces a similar result. Any collection of mucus or pus in the bronchi reduces the intensity of the vibrations, and may even make the fremitus absent. In vesicular emphysema the conductivity of the lung is greatly impaired, and vocal fremitus becomes diminished in consequence. In a pleuritic effusion in young children vocal fremitus is usually not much diminished, unless there be a large accumulation, as in an extensive empyema. The fremitus is generally absent over a thoracic tumour, but a mediastinal growth may be so situated as to conduct the vibrations directly from the bronchi to the chest wall.

2. *Pleural and Bronchial Fremitus.*—Occasionally a fremitus, of a rubbing character, may be perceived on palpation when the pleural surfaces are roughened in cases of pleurisy. Vibrations of the bronchial tubes, produced by sibilant and sonorous rhonchi, are sometimes so strong as to give a distinct fremitus. Coarse râles often produce fremitus.

3. *Fluctuation.*—In large pleuritic effusions, and also in empyema, fluctuation may sometimes be obtained. An empyema may point externally, and over the swelling thus produced there is often a considerable amount of inflammatory œdema.

Pulsation in the Vessels of the Neck.—Pulsation in the episternal notch can best be felt by directing the patient to bend the head forward, and by inserting the tips of the fingers above and behind the sternum. Marked pulsation in this region is usually due to a simple dilatation of the aorta, but if associated with a sense of resistance or tumour it is caused by an aneurysm.

Pulsation in the large vessels of the neck may be of the arteries, or veins, or both. If there be a marked pulsation in the neck and a feeble radial pulse, the pulsation in the neck is certainly venous. Pulsation in the carotid arteries is not visible, or only very slightly, in a healthy and well-nourished person, but it becomes evident whenever the heart is beating forcibly. It is most pronounced in aortic regurgitation with hypertrophy of the left ventricle. Undue pulsation of the arteries of the neck occurs in patients suffering from exophthalmic goître, and is also present in severe forms of anæmia.

Pulsation in the jugular veins is most marked in valvular incompetence of the right side of the heart. The pulsation occurs with each systole of the right ventricle, and indicates tricuspid incompetence with regurgitation of the blood into the veins. Engorgement of the jugular veins takes place whenever there is any obstruction to the blood-flow through the right side of the heart ; the right ventricle becomes distended with blood, and when the right auricle contracts, some of the blood regurgitates into the veins, and a pulsation, the auricular wave, is produced, which occurs before the ventricular systole. To these two forms of pulsation in the jugular veins the terms ' ventricular venous pulse ' and ' auricular venous pulse ' have been given.

Diastolic collapse of the veins, *Friedreich's sign*, which is produced during the ventricular diastole, is an indication of an adherent pericardium; it is found chiefly in this condition, but does not always occur, and is sometimes seen without any pericardial adhesions being present.

Slight pulsation of the veins of the neck may arise in health without any distension. Very often what appears to be venous pulsation is simply a transmitted movement from the carotid artery.

Tracheal Tugging.—This occurs when an aortic aneurysm presses upon the trachea or left bronchus. The patient should be seated in a chair with his head slightly thrown back. The observer stands behind the patient, and, with one hand on each side of the neck, presses the two forefingers beneath the cricoid cartilage, and gently pulls upwards. The trachea is then felt to be tugged downwards with each beat of the heart.

CHAPTER III

MENSURATION AND SUCCUSSION

Mensuration.—By means of mensuration the mobility of the chest can be examined, and the two sides compared as to their size and as to their amount of expansion. Some of the results arrived at by inspection and palpation are confirmed by this method of examination. The chest may be measured by the graduated tape, but to ascertain the circumference of the chest is not of much diagnostic value, as this measurement varies so much in health. In a healthy adult male of the average height the circumference of the chest at the level of the nipples is about 32 or 33 inches at the end of expiration. In quiet respiration there is an increase of nearly an inch during inspiration, but if the patient be directed to take a deep breath the increase is usually from 2 to 4 inches. The amount of expansion of the chest as a whole can be determined in this manner.

By means of a double tape the measurements of the two sides of the chest can be compared. The double tape is made by two graduated tapes joined together at the commencement of their scales. The line of union of the tapes is placed over the vertebral column, while the tapes are carried round the sides of the chest to the middle line in front. In this way the circumferences and the movements of the two sides can be simultaneously observed. These measurements can be made at any point; but they are generally performed either at the level of the nipples or the sterno-xyphoid articulation. The right side of the chest is usually about ½ inch larger than the left in circumference; in left-handed people the sides are commonly equal, but sometimes the left is larger. By this method of mensuration any enlargement or shrinking of one side of the chest can very easily be detected. Mensuration is useful in examining cases of pleuritic effusion, for the extent of the enlargement, and the diminution or loss of movement of the affected side, and the increased expansion of the healthy side, can be clearly demonstrated. Measurements at various intervals of time may show an increase or diminution in the amount of the effusion. Enlargement of the affected side, with defective expansion, is found especially in pleurisy with effusion, pneumothorax, hydrothorax, and empyema. A smaller measurement on the affected side, with defective expansion, is found usually after the absorption of a pleuritic effusion, when retraction of the chest wall has taken place in pulmonary tuberculosis, and in fibrosis of the lung. Many other variations in the extent of the respiratory movements, the forms and causes of which have already been described (p. 35), can be confirmed by mensuration.

When bulging in the præcordia occurs from pericarditis with effusion or hypertrophy of the heart, the measurement between the left nipple and the middle line in front is usually greater than a corresponding measurement on the right side.

Various diameters of the chest can be measured by means of a pair of steel callipers. The antero-posterior measurement, which is diminished in phthisis and

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increased in emphysema, is the most important. In the average well-developed adult the antero-posterior, *i.e.*, the sterno-vertebral, diameter, as measured by callipers, is about 10 inches. The antero-posterior diameters of the apices of the lungs may be compared in this way. One point of the callipers is placed immediately below the central point of the clavicle, and the other on the spine of the scapula, a point being marked on the spine of each scapula at equal distance from the vertebral column. Of course, many fallacies in making these measurements occur, but with a little practice a fairly accurate estimation of these diameters can be made. The antero-posterior diameter over the apex of the right lung is not usually in health more than ¼ inch larger than that of the left.

A simple cyrtometer can be constructed out of two strips of thin lead sheeting, about 24 inches long and ½ inch in width. They may be joined together by a short piece of india-rubber tubing. The tubing is placed over the vertebral column behind, and the strips are carried round the sides of the chest to the middle line in front. Care must be taken to bend the lead accurately to the curves of the chest wall. In the middle line in front it is more convenient to turn back the ends which would otherwise overlap. The lead follows closely the outlines of the chest, and when removed retains its shape. The cyrtometer can then be laid on a piece of paper, and its curves marked out on it, so forming a permanent record of the shape of the chest, and one from which measurements can be made. If the two sides of the cyrtometer are folded upon each other at the point made by the india-rubber hinge, any differences in the shape and size of the two sides of the chest are very clearly demonstrated. It is best to make the observations about 2 inches below the nipples, which corresponds to the sterno-xyphoid articulation, as this level is below the pectoral muscles and the scapulæ. It is more satisfactory to use this level, as the cyrtometer does not record sharp bends very accurately.

Many other instruments have been devised for recording the form and movements of the chest in health and disease, and among these are Dr. Graham Brown's *perigraph*, Marey's *pneumograph*, Gibson's *chest-measurer*, and Quain's *stethometer*.

Succussion was used by Hippocrates, and bears his name. The patient should preferably be sitting up, and, while the observer's ear is applied to the chest, should be sharply shaken or jolted. If the patient be well enough, he may be directed to shake himself, and so bring out the sound. The succussion sound is a splashing noise with a metallic ringing quality, and it can only be produced when air and fluid exist together in a cavity. It is heard chiefly in cases of pneumothorax. Sometimes, however, it can be elicited when there is a large tuberculous cavity in the lung containing both air and fluid. It may also be heard after paracentesis has been performed for an empyema, as the condition may become practically that of a pneumothorax. In a case of pneumothorax the patient himself is often conscious of the fluid in his chest, and can both feel and hear the splashing. A similar sound may be produced in the stomach on shaking the body when that organ is distended with air and fluid.

CHAPTER IV

GENERAL CONSIDERATIONS OF PERCUSSION OF THE THORAX

PERCUSSION, the act of tapping the surface of the body, and listening to the sounds so produced, was first described by Avenbrugger in 1761. The sound which is produced by this act is called the *percussion note* of the part. It is necessary to observe the character of the sound and the degree of resistance afforded by the part percussed. When a portion of the surface of the chest which covers healthy lung is percussed, a clear *resonant* sound is produced ; when, on the other hand, percussion is performed over the part of the heart which is uncovered by lung, a *dull* toneless sound is elicited. The sounds are not pure and simple notes, for they are the result of a complexity of vibrations. The percussion sound must be considered according to its following properties—intensity, pitch, quality, and duration.

The *intensity* of a sound depends on the greater or less energy by which the sound is produced, upon the nature and density of the body which is to transmit it, and on the presence of other bodies, capable of vibrating together with the principal body.* *A resonant sound is greater in intensity than a dull sound.*

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* Pietro Blaserna, 'The Theory of Sound in its Relation to Music.' 1898.

The *pitch* of a sound depends on the number of vibrations that the sounding body makes in each second of time. Low notes are the result of a small number of vibrations, and high notes of a larger number. *A resonant sound is lower in pitch than a dull sound.*

The *quality* or *timbre* of the percussion sound can only be learned and appreciated by careful and frequent observation. The timbre is the 'difference between sounds, otherwise the same, proceeding from different materials, instruments, or voices.'* *A dull note is harder in quality than a resonant one.*

The *duration* of a sound depends upon the number of times the vibrations are repeated. *A resonant sound is longer in duration than a dull sound.*

Modes of Percussion.—There are two methods of percussion—the *immediate* and the *mediate.*

Immediate percussion is that in which the part to be examined is directly struck with the striking body. This was the method originally employed, and is very little used now except in percussion over the clavicles. Over the clavicles immediate percussion is performed with the percussing finger, as in mediate percussion. Over any other part of the body immediate percussion is made with the four fingers united in one line, and percussion is performed with the ends of the fingers, the stroke being given, not obliquely, but perpendicularly. When a large portion of one lung is consolidated, and when there is a large pleuritic effusion on one side, immediate percussion renders the difference between the percussion sounds of the two sides of the chest very obvious.

Mediate percussion is that in which the finger or some other form of pleximeter is laid upon the part to be examined, and receives the stroke. The substance which is placed between the part struck and the striking body is called the *pleximeter*. Many forms of pleximeters have been invented, such as plates or discs of ivory, wood, metal, leather, and india-rubber. The striking body is called the *plessor*, and a variety of hammers has been used, including the rim of the larger end of the wooden stethoscope. The middle finger of the left hand, however, forms the best and most convenient pleximeter, and is the finger commonly preferred. The palmar surface of the finger must be placed firmly and evenly upon the part to be examined, and the stroke should be received upon the centre of the middle phalanx. Sometimes the index finger is used, and occasionally all the fingers are employed for this purpose. The best plessors are the fingers of the right hand. The middle finger may be employed alone, or this finger may be supported by the index finger, their ends being on exactly the same level.

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* Alexander Bain, 'The Senses and the Intellect.' 1868.

Percussion is performed by means of the bent finger or fingers of the right hand striking the middle phalanx of the index or middle fingers of the left hand. The stroke must be made perpendicularly and not obliquely, and the blow must be given with the ends of the fingers and not with their palmar surfaces. When the stroke is delivered by means of the finger, the movement should take place at the wrist only, not at the shoulder, elbow, or metacarpo-phalangeal joints. The blow must be given lightly and sharply, and the finger must be raised from the pleximeter immediately after the stroke, in order not to interfere with the free vibrations of the chest. The force of the stroke must be varied according to circumstances, since considerable force is often required to bring out deep-seated dullness, while very little force is necessary to demonstrate superficial dullness. More force is required when the chest wall is thickened from any cause. In order to percuss skilfully with the fingers, a considerable amount of practice is required; it is a mode of examination difficult to acquire, but one which may be perfected to a marvellous degree.

In examination of the thorax, the patient may be in the recumbent, erect, or sitting posture for percussion of the front of the chest, but for percussion of the sides and back of the chest he should be placed in the erect or sitting posture whenever possible. The patient should be in a position that is convenient for the observer, so that no strain is placed upon him in his examination. The patient should be directed to let his arms hang loosely by his sides when the front of the chest is being percussed, and care must be taken that he assumes no posture that will make the muscular tension of the chest wall unequal on the two sides. In percussing the apices of the lungs above the clavicles, the patient's head must be in the middle line, and not turned to one side. The axillary regions are best examined with the patient's hands clasped over his head. In percussion of the back of the chest, the patient should lean forward, and fold his arms across his chest in front. It is of very great importance, in order that corresponding points of the two sides of the chest be compared, that percussion be performed symmetrically. The percussion must be made with equal force on the two sides, and the finger receiving the blow must be applied with equal firmness and at equal angles to the ribs. It is best, whenever possible, to apply the finger or pleximeter parallel to the ribs.

Sense of Resistance upon Percussion.—The sense of resistance which is felt upon percussion gives very important indications as to the state of the underlying organs. This feeling of resistance can only be appreciated after considerable practice in percussion. The resistance of a body depends upon its elasticity; the greater the elasticity the less the resistance. The feeling of resistance is affected by the condition of the chest wall, and an increase in the resistance may be due solely to changes in it. Whenever the air is diminished in the lungs, the feeling of resistance is increased. The sense of resistance is more pronounced therefore in consolidation of the lung from any cause, also in œdema and compression. It is also greatly increased on percussion over pleural effusions and intrathoracic tumours. It is diminished in pulmonary emphysema when well marked, and in pneumothorax, if the pressure be not very high in the cavity.

CHAPTER V

EXAMINATION OF THE LUNGS AND HEART BY PERCUSSION

Examination of the Lungs by Percussion.

1. **The Pulmonary Percussion Note in Health.**—The percussion note varies considerably over different parts of the chest. The sound is more resonant during and at the end of inspiration than during and at the end of expiration. With the expansion of the lungs during inspiration the area of the pulmonary percussion sound is increased in every direction. The percussion sound is clear and resonant in the infra-clavicular region, and remains about the same, or even becomes slightly more resonant, on the right side down to the fourth intercostal space. Below this, on forcible percussion the dullness of the liver is brought out, but with light percussion the pulmonary resonance can be elicited down to the lower margin of the lung. The result is that, on percussion of the right side of the chest in the mammary line from above downwards, the note at first is clear and resonant, then becomes higher in pitch and less in intensity about the fourth intercostal space; and these modifications increase until suddenly the note becomes quite dull over the liver at the level of the sixth rib. On the left side the note in the infra-clavicular

region is usually not quite so resonant as over the corresponding area on the right side. On percussing downwards in the left mammary line, the note does not change at the fourth intercostal space, but is usually unaltered down to the sixth rib. A dull note is given over the præcordial region. The actual edges of the lungs overlapping the heart can only be ascertained by light percussion. Deep percussion will bring out the whole extent of the heart. The note over the sternal end of the clavicle is quite clear and resonant, but becomes higher in pitch towards the middle of the bone, and is quite dull at the acromial end. Above the clavicles a resonant note is obtained over the apices of the lungs, but the note is slightly less resonant on the left than on the right side. When percussion is performed over the sternum, the bone vibrates as a whole, and so the note elicited varies very little over its entire length. In the right lateral region a resonant note is given from the axilla down to the eighth rib, where the hepatic dullness commences. On the left side there is a clear resonant note from the axilla down to the eighth rib, where the stomach gives a tympanitic sound. The dullness over the spleen can usually be detected over the ninth and tenth intercostal spaces. The note over the lateral regions is more resonant than that over the pectoral muscles. Over the back of the chest the pulmonary note is not so clear or so resonant as in front. The note over the apices of the lungs behind is more muffled on account of the increased thickness of the chest wall, but still it is fairly clear and resonant. In the inter-scapular and infra-scapular regions a good resonant note is obtained. On the right side the pulmonary resonance extends down to the tenth rib in the scapular line, where the note becomes dull on account of the subjacent liver. On the left side the pulmonary resonance extends a little lower.

The percussion sound varies in the same regions in different individuals in health. The sound is less resonant when the chest walls are extremely muscular, or are thickly covered with fat. The note is more resonant when the chest wall is thin; also it is more resonant in children than in adults, and in females than in males.

2. **The Pulmonary Percussion Note in Disease.**—The percussion note is changed in various ways in disease. The normal resonance may only be slightly altered, and the change difficult to appreciate; but, on the other hand, there may be a marked and readily detected difference. The note is impaired or dull when the quantity of air is diminished or absent altogether in the part examined. It is exaggerated or hyper-resonant when the quantity of air in the part is increased. Impaired pulmonary resonance or a dull note may be due to—

(*a*) *Changes in the Lungs:*

Phthisis.
Pneumonia.
Broncho-pneumonia.
Abscess.
Gangrene.
Passive congestion.
Œdema.
Fibrosis.
Collapse.
Atelectasis.
Bronchiectasis.
Tumours.

(*b*) *Changes in the Pleuræ:*

Pleuritic effusion.
Empyema.
Thickened pleura.
Hydrothorax.
Hæmothorax.
Pneumothorax.
Tumours.

(*c*) *Other Changes:*

Mediastinal tumour.
Mediastinal abscess.
Aneurysm.
Encroachment of cardiac or hepatic dullness.

An increase in the pulmonary resonance may be due to—

(*a*) *Changes in the Lungs :*	(*b*) *Changes in the Pleuræ :*
Emphysema.	Pneumothorax.
Large vomicæ.	

By observing the locality and the extent of the abnormal changes ascertained by percussion, it is often possible to infer the nature of the disease. Thus, tuberculous consolidation generally first affects the apices of the lungs, and the disease is usually well advanced on one side before changes occur in the other. Consolidation due to pneumonia may involve only one lobe, whereas the dullness produced by œdema and passive congestion occurs at both bases, and does not correspond in outline to the lobes of the lungs. Pleuritic effusions and empyema usually affect one side, but both may be involved, especially in children. In broncho-pneumonia there may be small scattered patches of impaired resonance. Pneumothorax is almost invariably confined to one side. Pulmonary emphysema is usually distributed over both lungs, but parts only may be involved, or one side, when the emphysema is compensatory to disease in other regions of the lung, such as collapse, fibrosis, compression, etc. Areas of dullness are sometimes found to shift slightly their position upon a change in the posture of the patient, and this only occurs in pleuritic effusions and in pneumothorax. A large cavity in the lung may be full of muco-pus at one time, and in this condition the percussion note is dull; at another time the cavity may be empty and the note resonant. The note over a pneumothorax may be resonant, provided that the distension is not great; but if the distension be excessive, and the cavity contains in addition serum or pus, the note is usually dull or greatly impaired, especially over the base of the lung. When much fluid is present in a pneumothorax the note changes considerably with the position of the patient. When dullness is found at the base of one lung posteriorly in cases of pleuritic effusion, a triangular area of dullness can frequently be detected on the opposite side of the chest close to the vertebral column. This is known as *Grocco's paravertebral triangle.* The triangle is long and narrow, and the apex, which is above, does not reach quite so high as the dullness corresponding to the upper level of the pleuritic effusion (Fig. 11).

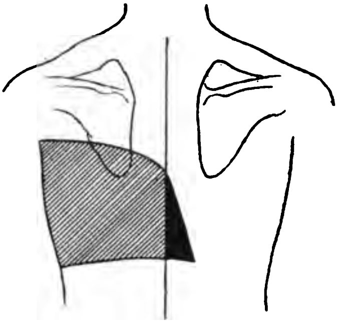


FIG. 11.—GROCCO'S PARAVERTEBRAL TRIANGLE.

The tympanitic percussion sound, which may be compared to the tone of a drum, is different from all other sounds produced during percussion, in that it approaches much more nearly to a musical note. The best example of a tympanitic sound is that which occurs on percussion over the stomach when moderately distended with gas. A tympanitic note may be obtained over a pneumothorax, provided that the distension is not too great.

If the cavity contains a considerable amount of fluid in addition, the pitch of the tympanitic note changes slightly with the position of the patient. Large cavities in the lungs when filled with air, and near enough to the surface of the chest wall, also give a tympanitic note. If there be free communication with a bronchus, the pitch of the note is lower when the mouth is closed than when it is opened. The pitch of a tympanitic note is lower over a large than a small cavity, and the pitch also falls when the opening into the cavity is narrowed or closed.

Skodaic Resonance.—When a pleuritic effusion exists in the lower part of the chest, a slightly modified tympanitic note can often be obtained over the subclavicular region on the same side. This is caused by the relaxation of the lung tissue above the effusion, and the note produced is spoken of as *Skodaic resonance.* In a small effusion Skodaic resonance can often only be elicited just above the upper border of the fluid; in a large effusion it may be detected all over the lung above, and in an excessive effusion the lung is so compressed that this note is not obtained. This form of resonance is also sometimes found in the first stage of pneumonia, before hepatization has occurred, and is then probably due to the relaxation of the lung tissue as a result of the inflammatory changes. It can often be obtained over the lung, just above a consolidated area. It is also found over a lung which has commenced to expand after being compressed by a pleuritic effusion. The pitch of the Skodaic resonance is not altered by opening and closing the mouth.

The tubular percussion sound is that given over the healthy trachea, and is decidedly tympanitic. It may be obtained upon percussion over a consolidated portion of the lung, or over a tumour intervening between a large bronchus and the surface. The impulse of the percussion stroke is transmitted directly to the bronchus. The pitch is altered by the patient opening and closing the mouth.

The cracked pot sound was compared by Laennec to the noise produced on striking a cracked pipkin. It can be well imitated by folding the hands loosely together, and striking the back of one against the knee. The sound is caused by the sudden expulsion of air from a cavity through a small orifice. The cracked pot sound is best obtained over a large cavity in the lung. The patient should be directed to keep his mouth open, and the percussion stroke must be given sharply, and the fingers permitted to rest for a moment on the pleximeter. It is only occasionally that this sound can be obtained over a cavity. It can also be produced on rare occasions over a pneumothorax when a fistula is present. Forcible percussion will sometimes elicit a very similar sound in children when there is narrowing of the glottis. It can also be obtained by faulty percussion when the finger or the pleximeter is not evenly applied to the chest wall.

The amphoric sound gives the idea of hollowness, and has a peculiar metallic quality. It may be heard upon percussion over a very large cavity, which must be superficial and have firm but thin walls, with a very small or no external communication. This sound can only be elicited over a large cavity in the lung, or over a pneumothorax.

Examination of the Heart by Percussion.

By percussion the size and position of the heart can be ascertained, and the extent to which it is overlapped by the lungs can be determined. The presence of pericardial effusion is also indicated by percussion.

There are two areas of cardiac dullness—the deep or relative, and the superficial or absolute.

The area of *deep cardiac dullness* corresponds to the actual outlines of the heart on the chest wall, which have already been described. In mapping out the area of deep cardiac dullness, percussion, which must be performed rather forcibly, should be made towards the heart, commencing over the resonant lung. The first change in the note indicates the outer margin of the deep cardiac dullness. The area of deep cardiac dullness reaches above to a line drawn across the sternum at the level of the third costal cartilages. The right border extends ½ inch to the right of the sternum at the level of the fourth costal cartilage. The left border extends to just outside the apex-beat, and is about 3½ inches to the left of the mid-sternal line in the fourth and fifth intercostal spaces. Below the deep cardiac dullness passes into that of the liver. The transverse diameter of the deep cardiac dullness is normally about 4½ inches. Although this is the area usually given for the outlines of the deep cardiac dullness, yet in health no dullness can be made out to the right of the sternum. It is only when the right lung is shrunken, or when the heart is enlarged, that any dullness can be determined to the right of the sternum. The outline of the deep cardiac dullness on the left side can always be mapped out, unless the lung be emphysematous, or there be some dullness due to diseases of the left lung or pleura, which is continuous with the cardiac dullness.

The area of *superficial cardiac dullness* corresponds to that portion of the heart which is uncovered by the lungs. The upper limit of the dullness is the fourth left costal cartilage, and the left border is indicated by a line from the junction of the fourth left costal cartilage with the sternum to the apex-beat. The right border corresponds to the anterior margin of the left lung in the mid-sternal line, but on account of the resonance of the sternum the right border of the superficial area of cardiac dullness can often only be appreciated as far as the left edge of the sternum. Below, the cardiac dullness is continuous with that of the liver. The area of superficial cardiac dullness is therefore very small, and almost triangular in shape.

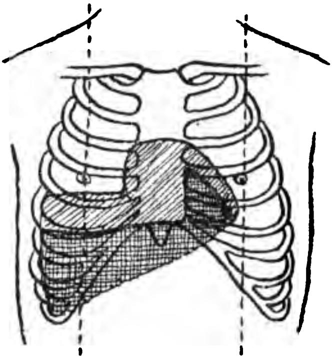


Fig. 12.—Superficial and Deep Cardiac and Hepatic Dullness.

The area of superficial cardiac dullness only gives information as to how much of the heart is uncovered by the lungs, and may give no indication of the size of the heart. Nevertheless this area is altered in size by diseases both of the lungs and of the heart. The area of dullness may be diminished even when the heart is large, on account of there being pulmonary emphysema.

The area of superficial cardiac dullness is diminished in emphysema of the lungs, and may be entirely absent when the emphysema is well marked. The heart becomes covered more or less completely by the enlarged lungs. It is also diminished occasionally in the atrophy of the heart which is apt to occur in chronic diseases accompanied by great emaciation, such as tuberculosis and carcinoma. This diminution in the size of the heart is usually overlooked, and, in order to ascertain it, there should be a careful mapping out of the area of deep cardiac dullness. In the very rare condition of *pneumopericardium*, when gas is present in the pericardial sac, the percussion note may be resonant all over the cardiac area. No area of cardiac dullness may be made out on the left of the sternum in displacement of the heart to the right, as in pneumothorax, or congenital transposition. There is an increase in the area of superficial cardiac dullness in enlargement of the heart itself, in effusions into the pericardium, and in any condition causing retraction of the overlying portions of the lungs. The heart may be enlarged from hypertrophy, from dilatation, or from hypertrophy and dilatation existing together. The area of cardiac dullness is increased downwards and to the left in enlargement of the left ventricle. In aortic regurgitation the downward increase is more marked than the lateral In mitral regurgitation the increase to the left is usually more than in aortic regurgitation, as in the former there is sooner or later enlargement of the right ventricle, which displaces the left border still further. The area of cardiac dullness is extended to the right of the sternum with hypertrophy or dilatation of the right ventricle, and with dilatation of the right auricle. In enlargement of the heart the cardiac dullness often extends upwards to the third left costal cartilage. This increase upwards is also seen in marked anæmia. An upward increase in the area of cardiac dullness is usually due to an enlargement of the right ventricle, as can be seen by examining Fig. 3. When the right ventricle is enlarged, it displaces the left ventricle backwards, so that it lies further from the anterior chest wall. When the dullness reaches above the third left costal cartilage, it may be due to pericarditis with effusion.

In *pericarditis with effusion* the area of cardiac dullness assumes a pyramidal or pear-shaped outline, with the apex above and the base below. In a large effusion the outline is 'that of a bag of fluid spreading out at the base' (Dr. Ewart), so that the lower left angle of the dullness extends beyond the region of the apex, and the lower right angle is situated in the fifth intercostal space just to the right of the sternum (*Rotch's sign*). The rounded apex of the pyramid often reaches as high as the second left costal cartilage, and sometimes even beyond this. The sense of resistance upon percussion over the præcordia when there is a pericardial effusion is greater than over the normal heart. Dr. Ewart has pointed out that in pericarditis with effusion the upper edge of the first rib can be felt as far as its sternal attachment (*Ewart's first rib sign*), and also that a patch of dullness, the shape of a square, occurs over the base of the left lung behind, close to the vertebral column. There may be difficulty in diagnosis between pericarditis with effusion and cardiac dilatation, and the differences in the physical signs of the conditions are given on p. 110.

Displacement of the Heart.—The position of the heart is altered by various causes, and in consequence there is a corresponding displacement of the superficial and the deep cardiac dullness. The heart is displaced to the right, in congenital transposition of the organ, by a left pleural effusion or left pneumothorax, or by contraction of the right lung. It may be displaced to the left by a right pleural effusion or right pneumothorax, or by contraction of the left lung. It may be displaced upwards by anything which raises the level of the diaphragm, such as ascites or an abdominal tumour. In the last condition the cardiac apex is not only raised, but swung out a little to the left. The heart may be displaced downwards by an intrathoracic tumour, and slightly in pulmonary emphysema.

Thoracic Aneurysm.—Over an aneurysm of the thoracic aorta dullness on percussion can often be obtained. This depends upon the size and situation of the aneurysm and upon the amount of lung tissue overlying it. Aneurysms of the ascending and of the transverse portion of the arch produce dullness at the right of the sternum in the second and third interspaces and over the manubrium sterni respectively. An aneurysm of the descending thoracic aorta sometimes gives rise to dullness posteriorly on the left side of the vertebral column. Abscesses and tumours in the anterior mediastinum often lead to dullness on percussion, while an enlarged thymus in children will modify the percussion note in this region.

CHAPTER VI

AUSCULTATION OF THE LUNGS

AUSCULTATION is the act of listening to sounds produced within the body, and audible on its external surface.

Method.—The auscultation of the lungs may be performed with the aid of a stethoscope, or by the ear of the observer being directly applied to the thoracic wall. The former method of auscultation is called mediate, and the latter immediate. The mediate method is the one in common use, and for it many different forms of stethoscopes have been devised. A stethoscope is an instrument to conduct sound, and Laennec's first stethoscope was simply a roll of paper. The simple wooden stethoscope has been largely replaced by the binaural. The latter has the advantage that it can more easily be applied to any part of the chest wall. The straight wooden stethoscope is, however, a better conductor, and is preferable for auscultation of the heart. There are conditions when the wooden stethoscope cannot be employed easily, but there are practically no circumstances under which the binaural stethoscope cannot be used. When the patient is too ill to sit up, the binaural stethoscope is very much more convenient, and almost essential in order to examine the chest posteriorly. Children do not like the pressure of the wooden stethoscope.

The chest must be fully exposed as in percussion, and the position of the patient must be unconstrained and easy. In examination of the front of the chest, the patient may be in the recumbent, sitting, or erect positions, but for examining the apices of the lungs the erect position is certainly the most convenient. The sides of the chest are best examined with the patient's arms raised and the hands placed upon his head. In examining the chest posteriorly it is best to direct the patient to cross his arms in front and to lean forwards. The chest-piece of the stethoscope must be applied firmly and evenly to the surface, without the intervention of any clothing. No portion of the bed-clothes, or the patient's or observer's dress, should come in contact with the stethoscope. In patients who have much hair upon the chest, care must be taken that the friction of the hair with the stethoscope be not mistaken for adventitious sounds within the thorax. To avoid this fallacy, moistening the hair with water is all that is necessary. Care must also be taken that friction be not produced between the skin and the stethoscope, when the patient takes a deep breath.

In auscultation of the lungs it is necessary to observe corresponding points on the two sides of the chest, and also to contrast different parts on the same side. It is best to auscultate the chest first of all while the patient is breathing quietly and in his natural manner. Afterwards the examination should be repeated while the patient is breathing deeply. The breathing must be performed slowly, quietly, and smoothly; that is, it must not be hurried, no noise should be made in the mouth and nose, and it must not be performed spasmodically.

Auscultation of the lungs is practised for the following three objects :

1. To determine the character of the breath sounds.
2. To detect the presence of any adventitious sounds.
3. To ascertain any alteration in the vocal resonance.

Character of the Breath Sounds in Health.—In order to determine the character of the breath sounds it is necessary to be familiar with them in health as heard over the trachea, over a bronchial tube, and over the lung.

The tracheal breath sounds are heard over the trachea and larynx, and convey to the ear the idea of air passing through a tube of large dimensions. The sounds are loud, harsh, blowing, hollow, and tubular in character. The sounds produced by inspiration and expiration are equal in length, and very similar in all their characters. There is a distinct interval between the end of one sound and the beginning of the next. The tracheal breath sounds may be represented as follows:

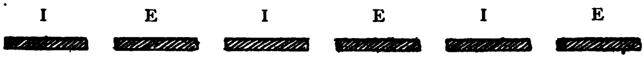


FIG. 13.—DIAGRAM OF TRACHEAL BREATH SOUNDS.

The bronchial breath sounds may be heard over the sterno-clavicular articulations, and often, though not always, in the inter-scapular regions. The sounds are very similar in character to the tracheal, but are not so pronounced. There is a distinct interval between the end of inspiration and expiration. They may be represented as follows :

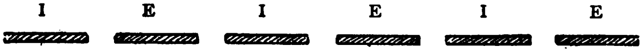


FIG. 14.—DIAGRAM OF BRONCHIAL BREATH SOUNDS.

The pulmonary breath sounds are spoken of as the vesicular murmur, and are quite different from the former two. The inspiratory sound is soft, breezy, uniform, and continuous. The expiratory sound follows immediately that of inspiration, and there is no interval to be observed between them. It is only about one-quarter the length of that of inspiration, and is much weaker in character, so that it is often inaudible. The sounds may be represented as follows :

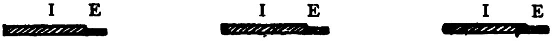


FIG. 15.—DIAGRAM OF PULMONARY BREATH SOUNDS.

These sounds are probably produced by the air entering the alveoli of the lungs. It has, however, been suggested that they are the tracheal breath sounds modified by transmission through the lung tissue. They can be heard all over the surface of the lung, but vary in character slightly in different regions.

In children the normal vesicular sounds are louder and harsher than in adults on account of the thinness of the chest wall and the greater elasticity of the lungs. This form of breath sounds has been described as *harsh* or *puerile.*

Variations of the Breath Sounds in Health.—There are certain modifications of the breath sounds which are compatible with health. The vesicular murmur may be increased or diminished in intensity according to the thickness of the chest wall and the depth of the breathing. The intensity varies also in different parts of the chest ; the breath sounds are louder in the upper than in the lower half, especially in women, and in front than behind. The vesicular murmur is a little louder and more harsh on the right than on the left side over the apex of the lung.

The Breath Sounds in Disease.—As a result of disease of the lungs and pleuræ the vesicular murmur may show slight modifications, or it may be replaced by others of quite a different character. The chief modifications of the vesicular murmur are—

Intensity	Increased—*i.e.*, harsh breath sounds.
	Diminished—*i.e.*, weak breath sounds.
	Absent.
Rhythm	Jerky, wavy, cogged-wheel inspiration.
	Prolonged expiration.

Increased Intensity (*Harsh Breath Sounds*).—This occurs under many circumstances. When a portion of the lung is receiving less air than normally, either from consolidation or compression, the healthy neighbouring portions will receive more air, and so in the latter the vesicular murmur will be louder. This is spoken of as harsh breathing. Harsh breathing, therefore, occurs over healthy portions of the lung in cases of pneumonia, broncho-pneumonia, pleuritic effusions, compression, etc. Harsh breathing is also normally present in young children, when it is spoken of as *puerile*. Harsh breathing, on the other hand, may be accompanied by some prolongation of expiration, and under such circumstances may be due to diminished elasticity of the lung tissue, as is found in early phthisis.

Diminished Intensity (*Weak Breath Sounds*).—The following are the chief causes: Deficient action of the muscles of respiration, due to debility, paralysis, or pain; obstruction in the bronchi by the accumulation of secretions; the very early stages of pneumonia, emphysema, œdema of the lungs, and hypostatic congestion; compression of the lungs by pleuritic effusions, tumours, pericardial effusions, enlarged heart, etc.; anything intervening between the lungs and the chest wall, pleuritic effusions, pneumothorax, thickened pleura; increase in thickness of the chest wall; compression of the trachea and bronchi by tumours, etc.

Absent breath sounds may be noted in many of those conditions, if they be severe enough, which cause diminished intensity of the breath sounds. Total absence, however, is found chiefly under the following circumstances: in a large pleuritic effusion, especially empyema, in pneumothorax, and when a bronchus is completely obstructed.

Rhythm—Jerky Inspiration.—In vesicular breathing the inspiratory sound is normally uniform and continuous; it may, however, become jerky and wavy. Sometimes inspiration is made up of a series of jerks, or is not uniform in strength, or it may suggest the idea of the movement of a cogged wheel. These variations of the inspiratory sound may be heard all over the lungs, and often occur in nervous individuals; they generally disappear on the patient taking a deep breath. Sometimes, however, they are localized to one spot, and are not affected by the depth of inspiration. Under such conditions jerky inspiration must always be regarded with suspicion, since, if localized at an apex, it may be an early indication of phthisis.

Prolonged Expiration.—In health the sound produced during expiration is about a quarter the length of that during inspiration. Prolongation of the expiratory sound is caused by loss of elasticity of the lung tissue, and also by some obstruction to the escape of air. The expiratory murmur is, however, sometimes slightly prolonged over the apex of the right lung even in health. Prolongation of the expiratory sound is one of the earliest signs of phthisis, and the more limited the area over which it is heard, the more likely is this disease the cause of it. In pulmonary emphysema the expiratory sound is greatly prolonged, and may be even twice as long as the inspiratory. This condition is found also in bronchial asthma.

The vesicular breathing may be replaced by others of quite a different character, so that there may be bronchial breathing, cavernous breathing, and amphoric breathing.

Bronchial or tubular breathing has already been described as to its character on p. 73, and it is heard in health only over the sterno-clavicular joints, and sometimes in the inter-scapular regions. It becomes evident over other parts of the chest when there is consolidation of the underlying lung. The solid lung becomes a better conductor of the sounds from the bronchi, and the vesicular murmur disappears, so that the bronchial breathing becomes audible and unconcealed by any vesicular murmur. It is necessary, however, that the bronchi should be open, and not full of secretions. The sound of bronchial breathing can well be represented by whispering the word 'choir.' Bronchial breathing is found to occur in pneumonic hepatization, in tuberculous consolidation, and also in consolidation of the lung due to collapse or compression. It is often heard, therefore, just at the upper limit of a pleuritic effusion. The higher the pitch of the bronchial breathing, the smaller are the bronchi in connexion with the consolidated area.

Cavernous breathing is a further stage of bronchial breathing, and it gives the impression to the ear of air entering and leaving a hollow space or cavity; it is much lower pitched than bronchial breathing. The sound may be represented by whispering the word 'choir' with the mouth as wide open as possible. It is heard over phthisical cavities provided that they are superficial, having firm walls, and being in direct communication with a large bronchus. Cavernous breathing may also be heard over dilated bronchi, as in bronchiectasis. The sounds are often decidedly blowing in character, and the pitch of the sounds may give some indication of the size of the cavity. The larger the cavity the lower is the pitch.

Amphoric breathing is an exaggeration of cavernous breathing. The sound resembles that which is produced by blowing into a wide-mouthed empty jar. It is heard over large pulmonary cavities, with smooth, firm walls and with free communication with a bronchus. It is also found in cases of pneumothorax when a communication exists between a bronchial tube and the pleural cavity.

Adventitious Sounds.—In health the respiratory murmur is unaccompanied by any other sounds, but in disease of the lungs and pleuræ abnormal or adventitious sounds may be heard on auscultation. These sounds may be produced either in the lung or pleura. Friction sounds may be produced between the stethoscope and the chest wall, especially if the chest be hairy, and care must be taken not to mistake these for true adventitious sounds, as mentioned on p. 72.

The adventitious sounds produced in the lungs are called râles and rhonchi, and these words are synonymous, but custom has assigned the term 'râles' to all the adventitious sounds produced in the lungs, and the term 'rhonchi' to those râles which give the impression to the ear that they are dry sounds. Much confusion of terms has arisen by the sounds being too minutely subdivided.

Râles may be classified as follows—

Moist râles :
- (*a*) Fine crepitations.
- (*b*) Medium crepitations.
- (*c*) Coarse crepitations or bubbling râles.

Dry râles or rhonchi :
- (*a*) Sonorous rhonchi.
- (*b*) Sibilant rhonchi.

The division of râles into moist and dry is made because they give this impression to the ear, but this is not accurate, as some of the apparently moist sounds are produced without the presence of fluid, and some of the dry sounds are due to the collection of more or less thick secretions. Moist sounds give the impression to the ear of bubbles of air bursting on the surface of a fluid. They are discontinuous sounds, produced in the alveoli, bronchioles, or bronchi.

Fine crepitations are caused by the sudden separation of the alveolar walls, with the presence of exudation in the alveoli. They have been compared to the sound produced 'by rubbing transversely between the finger and thumb a lock of one's own hair close to the ear,' and also to the sound which is heard when 'separating the moistened forefinger and thumb near the ear.' Fine crepitations are composed of numerous fine, sharp sounds, equal in size, wholly limited to inspiration, and usually near its end. They are removed neither by coughing nor forced inspiration, but are intensified by them. They occur in the first stage of pneumonia, and also in early tuberculosis, and in collapse and œdema of the lungs. Similar crepitations may be heard over the bases of the lungs upon deep inspiration in a patient whose habitual breathing is shallow. Under these circumstances they are due to the opening of alveoli which have not been expanded for some time; after a few deep inspirations they disappear.

Medium crepitations are produced in the smaller bronchi. They vary in size, are irregular, and occur both during inspiration and expiration, though usually predominating during the former. They are found at the bases of the lungs in œdema. When, however, they are confined to the apices, they are an indication of pulmonary phthisis. In pneumonia undergoing resolution similar sounds are heard, and are called *redux crepitations*.

Coarse crepitations or coarse bubbling râles are produced in the larger or medium sized bronchi. They are unequal in size, vary in number, occur irregularly, and may be heard during inspiration and expiration. They occur in bronchitis, in bronchorrhœa, in bronchiectasis, and sometimes in cases of hæmoptysis. They also originate in pulmonary cavities. These bubbling râles vary in size, and this depends upon the size of the space in which they occur, and also upon the quantity and viscosity of the fluid in which they are produced.

Bubbling râles may be resonant or non-resonant. If they be non-resonant, the surrounding lung tissue is, as a rule, healthy. When the surrounding lung tissue is consolidated, the râles have a musical, high-pitched quality, and are spoken of as resonant. When there is a cavity of sufficient size with smooth walls, it acts as a resonator, and resonant râles are produced. If, however, the râles be non-resonant, consolidation or the presence of a cavity cannot, however, be excluded. The *metallic tinkling of Laennec* has a very high pitch, and is produced in large cavities. It resembles the sound which occurs when ‘a drop of water falls on the surface of a fluid contained in a half-filled decanter.' It is heard over a large tuberculous cavity, and also over a pneumothorax. Coughing is generally required for its production.

Dry râles or rhonchi originate in the bronchial tubes, and are produced by the narrowing of their lumen either by swelling of the mucous membrane or by the presence of viscid secretions. They vary greatly in pitch and character. The *sonorous rhonchi* are of low pitch, and snoring in character, often continuous, and varying in intensity and duration. They are produced in the larger bronchi, and occur both during inspiration and expiration. *Sibilant rhonchi* are of higher pitch, whistling or hissing in character, and are produced in the small bronchi. They occur mainly during inspiration. The larger bronchi, however, may be so narrowed as to produce sibilant rhonchi. These sounds are characteristic of bronchial catarrh and bronchitis, but also occur in bronchial asthma, and in any obstruction of the bronchi, either from secretion or external pressure.

Pleural Friction Sounds.—In health the parietal and visceral pleural surfaces glide smoothly and noiselessly over each other during the movements of respiration. In pleurisy, when the surfaces are dry or roughened, and when the exudation is small, the movements of the pleural surfaces produce friction sounds. The sounds give the impression to the ear that they originate very near the surface. They have a creaking or rubbing character, consisting of a series of jerking noises which are very abrupt and varying in number. They usually occur both during inspiration and expiration, but are often heard only during the former. When there is a large accumulation of pleuritic exudation, the friction sounds disappear, as the serous surfaces are separated. Friction sounds have to be distinguished from râles. Friction sounds appear of more superficial origin, they are unchanged after the patient has coughed, they are often more localized, and sometimes are greatly increased in intensity if the stethoscope be pressed more firmly on the chest wall. Pleural friction sounds may have to be distinguished from pericardial friction sounds. If the patient takes a deep breath and holds it, the former will cease, while the latter will continue.

Vocal Resonance.—Vocal resonance is the term applied to the sounds of the voice transmitted through the chest. The sounds differ when auscultation is performed over the larynx, the trachea, the larger bronchi, and the lung tissue. When the stethoscope is placed over the larynx of the person speaking, the voice is quite distinctly and very forcibly heard, and articulation is perfect. When placed over the trachea, the voice is also distinct and loud, but the articulation is not so perfect. When auscultation of the voice is performed over a bronchus, as in the inter-scapular regions, vocal resonance is still distinct and loud, but conveys the impression of distant origin, and articulation is very imperfect. Over the lungs vocal resonance is obscure, indistinct, and buzzing, and no articulation can be heard. Vocal resonance is greater in men than in women, in adults than in children, and in thin than in stout persons. It is slightly louder over the upper part of the right lung than over the left. With a deep voice the intensity is increased; with a shrill voice the distinctness of the resonance is better. When the vocal resonance is to be examined, the patient should be directed to say 'ninety-nine,' or 'one, two, three,' distinctly and with equal loudness each time. After the vocal resonance has been observed in this way, a similar examination must be made while the patient whispers these numbers.

In disease vocal resonance may be altered in intensity and in quality.

- Intensity
  - Diminution
    - Weakened.
    - Suppressed.
  - Increase
    - Slightly increased.
    - Bronchophony.
    - Pectoriloquy.
- Quality
  - Ægophony.
  - Amphoric resonance.

Intensity of the Vocal Resonance.—Vocal resonance may be weakened or entirely suppressed in pleuritic effusions, in pneumothorax, in thickening of the pleura, in malignant growths of the lungs and pleuræ, in pulmonary emphysema, and in obstruction of a bronchus.

Vocal resonance is increased in intensity in any disease producing consolidation of lung tissue which is in communication with pervious bronchi. The increase in intensity may only be slight, but if it be marked then *bronchophony* is produced. In bronchophony the vocal resonance is loud and distinct, and the sound appears to originate at the end of the stethoscope. In health bronchophony may be sometimes heard in the interscapular regions, but in disease the normal vocal resonance may be replaced by it over any part of the lungs. It occurs in pneumonia, in pulmonary tuberculosis, and also in bronchiectasis. In comparing the apices of the lungs in early phthisis, it is important to remember that in the normal chest vocal resonance is louder over the right apex than over the left. In pleuritic effusions in the lower part of the chest, vocal resonance is often increased at the apex on the corresponding side. When vocal resonance is more marked than in bronchophony, the sound is very similar to that which is heard over the larynx, and is called *pectoriloquy.* Articulation is perfect, and both spoken and whispered words can easily be heard by the auscultator. As a rule, pectoriloquy indicates a pulmonary cavity, but it may also be heard over consolidated lung without any excavation. Pectoriloquy may be heard without a cavity being present, and a cavity may exist without pectoriloquy.

Quality of the Vocal Resonance.—In *ægophony* the quality of the vocal resonance is so altered that it has a nasal character. It is most commonly found in cases of pleuritic effusion, and is heard over a small area corresponding to the level of the upper limit of the fluid. It is usually only present over the lower angle of the scapula. *Amphoric resonance* may be heard over a large cavity in the lung, or over a pneumothorax in free communication with a bronchus. The voice sound possesses a hollow and reverberating character, which is produced by a large quantity of air being thrown into vibration.

The bell sound, or the ‘bruit d'airain’ of Trousseau, occurs in cases of pneumothorax. When auscultation is performed over a portion of the pneumothorax, and a coin is placed on another portion and is struck with a second coin, the sound which is heard has a ringing metallic quality like that of the tinkling of a small bell, or like that of hammering upon a blacksmith's anvil. The sound is so characteristic that, when it has once been heard, no other sound can be mistaken for it.

The following table compares the physical signs of pleurisy with effusion and lobar pneumonia :

Pleurisy with Effusion.	*Lobar Pneumonia.*
Inspection. — Deficient expansion and definite increase in volume of affected side. Intercostal spaces obliterated. Displacement of apex-beat.	Affected side does not move so well. Increase in volume usually shown only by mensuration. No displacement of the apex-beat.
Palpation. — Confirms the above. Vocal fremitus diminished or absent.	Confirms deficient expansion. Vocal fremitus increased.
Mensuration. — Marked increase in the affected side.	Slight increase in affected side.
Percussion.—Dullness absolute with peculiarly wooden quality. Great resistance on percussion. Dullness does not correspond to a lobe; upper limit may change with patient's position. Displacement of the heart, liver, etc.	Note dull over affected lobe ; resistance not so marked. Dullness may correspond to surface markings of a lobe or lobes. No displacement of the neighbouring organs.
Auscultation. — Diminished or absent breath sounds. Bronchial breathing frequently heard, but distant. No crepitations as a rule. Vocal resonance diminished or absent. Ægophony at upper limit of fluid. Pleuritic friction sounds only in early and late stages.	Suppressed breathing in the very early stage. Harsh bronchial breathing with crepitations. Vocal resonance increased—bronchophony.

CHAPTER VII

AUSCULTATION OF THE HEART

Healthy Cardiac Sounds.—In auscultating over the præcordia of a healthy person, two sounds are heard with each beat of the heart. The first sound is dull, prolonged, and distant; the second sound is clearer, shorter, and more defined. The sounds over the centre of the heart may be represented by the syllables *lub-dup;* over the apex by *lubb-dup*, with the accent on the first syllable; over the base by *lub-dupp*, with the accent on the second syllable. In a cardiac cycle, the first sound, which is usually about three times as long as the second, is followed by a short silence; then the second sound occurs, and is followed by a long silence. The radial pulse occurs just before or just after the termination of the first sound; the carotid pulse occurs during the first sound.

The first sound is produced by the muscular contraction of the ventricular walls, and by the closure of the tricuspid and mitral valves. The second sound is caused by the closure of the aortic and pulmonary semilunar valves. Over different parts of the præcordia either the aortic or pulmonary element predominates. The aortic element predominates at the base of the heart on the right of the sternum, and the pulmonary element on the left side, while at the cardiac apex probably the second sound is composed chiefly of the aortic element.

It is necessary to know the events which occur during a cardiac cycle in order to appreciate the significance of the various sounds heard in health and disease. The cycle may be divided for convenience into two—systole and diastole, corresponding to the ventricular systole and diastole. When the heart is beating at the normal rate, systole is a little shorter than diastole. The first sound commences with the beginning of the ventricular systole and the closure of the tricuspid and mitral valves. The blood in the ventricles is during systole being driven into the pulmonary artery and into the aorta. The auricles are in a state of diastole. The second sound corresponds with the beginning of the ventricular diastole, when the pulmonary and aortic valves are suddenly closed, and the auriculo-ventricular valves are being slowly opened. During the last part of the ventricular diastole the auricular systole occurs, and drives the remaining blood in the auricles into the ventricles. The auricular systole is about one-tenth of the whole cardiac cycle.

The diagram of a cardiac clock on p. 88 has been constructed in order to show the sequence of events in a cardiac cycle both in health and disease.

To Distinguish between the First and Second Sound.—The first sound is synchronous with the apex-beat, and so may be timed from that. If, however, the apex-beat cannot be felt, then the sound which is synchronous with the carotid pulse is the first sound. In health there are other differences: the first sound is followed by a short silence, and the second by a much longer silence; the first sound is about three times as long as the second; the accent is on the first sound at the apex, and on the second sound at the base of the heart.

Auscultatory Areas.—The cardiac valves are placed so closely together, and correspond to such a small area on the chest wall, that by auscultation over them the sounds produced by each cannot be distinguished. It is found that the sounds which each produces are best

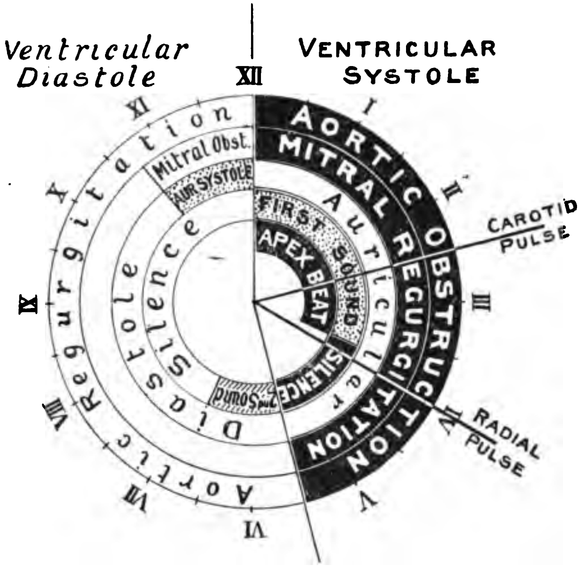


FIG. 16.—THE CARDIAC CLOCK.

heard over the chest wall at those points where the blood-stream which has just passed through the valves approaches nearest to the surface. Auscultation of the aortic valve is performed over the second right costal cartilage, of the pulmonary valve over the artery in the second left intercostal space, of the mitral valve over the apex-beat, and of the tricuspid valve at the lower end of the sternum. There are therefore four auscultatory areas, which are : the aortic area, the pulmonary area, the mitral area, and the tricuspid area, corresponding to the positions described above. Over all these areas the two cardiac sounds can be heard, but over the mitral and tricuspid areas the first sound is the louder, and over the aortic and pulmonary areas the second sound.

Modifications of the Cardiac Sounds.—The cardiac sounds may undergo changes (1) in intensity, (2) in rhythm, and (3) in character.

1. *Intensity.*—The cardiac sounds may be increased or diminished in intensity either together or relatively to each other.

Increased Intensity, or Accentuation.—The sounds may be increased in intensity or accentuated in functional derangements of the heart, in mental and bodily excitement, and in pyrexia. They may appear to be accentuated when the chest walls are thin. They are also accentuated and heard over a larger area when the neighbouring lung is consolidated. This occurs again when a pneumothorax is present, as the air acts as a resonator, and for a similar reason the cardiac sounds are often more clearly heard when there are large cavities in the lungs near the heart. In cases where a dilated stomach presses up the diaphragm, the heart sounds may have a consonating or metallic quality.

The first sound alone may be accentuated. In hypertrophy of the ventricles, the first sound is louder and more prolonged, caused by the increase in the muscular element of the sound and by the greater force with which the auriculo-ventricular valves are closed. In simple dilatation of the ventricles, the first sound is often slightly accentuated, but is usually sharper and shorter. The first sound is greatly intensified at the apex in mitral stenosis. Accentuation of the second aortic sound occurs in increased arterial blood-pressure, and so is well marked in cases of arterio-sclerosis and chronic interstitial nephritis. In dilatation or aneurysm of the arch of the aorta, the second sound is accentuated, because there is a larger mass of blood which recoils against the aortic valves. The second sound in the pulmonary area is accentuated when there is increased blood-pressure in the pulmonary circulation. This arises from disease of the lungs, as in emphysema, or from disease of the mitral valve, either obstruction or regurgitation, which hinders the passage of blood through the left side of the heart. Accentuation of the second pulmonary sound is a very important physical sign, as it indicates that the pulmonary valves are closed with greater force than in health. The intensity of the second pulmonary sound must always be carefully observed in diseases of the mitral valve. As long as the right side of the heart is competent to resist the increased work thrown upon it, this sound is loud, but when the right side begins to fail, the accentuation of the second pulmonary sound disappears.

Diminished intensity of the cardiac sounds occurs when the chest wall is abnormally thick, and when the heart is removed from the parietes by pericardial effusion or by the overlapping of an emphysematous lung. The first sound is enfeebled in any condition in which the contractions of the ventricular walls are weakened. This occurs in fever, when the heart is beginning to fail. It is produced by fatty degeneration of the cardiac muscle, in other myocardial degenerations, and in dilatation of the chambers of the heart. The second sound is diminished in intensity over the aortic area in mitral regurgitation, because the pressure in the aorta is usually lower than normal, and the pressure in the left ventricle is relatively higher at the beginning of diastole on account of the blood in the engorged left auricle passing rapidly into the left ventricle. The second sound is enfeebled over the pulmonary area in tricuspid regurgitation for a similar reason. In many cases of mitral stenosis the second sound is inaudible at the apex. The second sound at the apex is chiefly composed of the aortic element of the sound which is conducted by the left ventricle. The inaudibility of the second sound at the apex in mitral stenosis may therefore be due to the occurrence of hypertrophy of the right ventricle, which displaces the left ventricle further from the chest wall.

2. *Rhythm.*—Alterations in rhythm may occur under various conditions. The relative duration of the cardiac sounds and silences may be disturbed in disease. In the later stages of fever, with increased number of the cardiac beats, the first and second sound may become very similar in character, and equidistant—*embryocardia.* The ventricular systole and diastole become about equal in length. A similar condition occurs in overdoses of digitalis. Again, the rhythm may become irregular, with regard to the intensity and the duration of the sounds, and in the duration of the silences. These changes may be due to mental excitement, to various cardiac neuroses, to the action of certain drugs, to changes in the valves, to diseases of the myocardium, and to pericardial adhesions. Of all cardiac lesions, mitral stenosis exhibits most marked irregularity. The cardiac sounds may show *intermittence*, in which there is a pause corresponding to one or more complete cardiac cycles. The beat may intermit at regular intervals, and this condition is associated with various

cardiac lesions; but it may be present without any organic disease of the heart. A bigeminal or trigeminal condition of the cardiac beats occurs when the silence after each second or third beat is longer than the others. Sometimes many of the contractions of the ventricles are so feeble that they cannot be appreciated when the radial pulse is felt.

The *pulsus paradoxus* is due to the cardiac beats becoming more feeble at the end of inspiration. This form of arrythmia is chiefly found in adherent pericardium.

Reduplication of the heart sounds is not uncommonly found in disease. The first or second sound may be double, so that there may be three or even four sounds to each cardiac cycle. *Reduplication of the first sound* is rare, but in mitral stenosis it is sometimes heard over the cardiac apex. The interposed sound is usually presystolic in time. In the canter or *gallop rhythm* there are three sounds, and the accent usually falls on the middle sound, which corresponds to the normal first sound. The short sound in front of this occurs during the ventricular diastole, and is thought to be caused by increased ventricular tension. It is a very unfavourable sign, and appears in cardiac failure, especially in that associated with chronic interstitial nephritis. *Reduplication of the second sound* at the base of the heart is liable to occur when the blood-pressure either in the pulmonary or systemic circulation is altered. This condition is very commonly found in mitral stenosis, but occurs in other forms of cardiac disease, and also in diseases of the lungs which increase the blood-pressure in the pulmonary artery. Sometimes in health the second sound is reduplicated towards the end of a deep inspiration. Reduplication of the second sound is more frequently heard over the base of the heart than over the apex. In mitral stenosis the phenomenon may occur at the apex as well, and is a very important sign. It is spoken of as the 'postman's knock.' When present at the apex, it indicates an early stage of mitral stenosis. The condition is not a true doubling of the second sound, but the second part of it is probably produced by the sudden rush of blood into the left ventricle from the distended left auricle at the commencement of the ventricular diastole.

3. *Character.*—The cardiac sounds may be altered considerably in character. In hypertrophy of the left ventricle the first sound is often muffled and prolonged; sometimes it is booming, and sometimes dull and lacking in clearness. In simple dilatation of the heart the first sound is often much clearer, shorter, and sharper than normally. In mitral stenosis the presystolic murmur at the apex terminates in a loud snap or thump, which represents the first sound. This change in the first sound may occur in mitral stenosis without any murmur being present. The first sound at the apex often appears rumbling and slapping, as the result of pure nervousness, and is not due to any organic change. The second sound is more frequently altered in character in the aortic region, and this change is usually associated with accentuation. Under this condition, the second sound may become ringing or booming, and sometimes it has a wooden or stringy character.

Murmurs.—Abnormal cardiac sounds, totally unlike the sounds produced by the action of the healthy heart, are called murmurs or bruits. Murmurs are divided into—

$$\text{Endocardial}\begin{cases}\text{Organic.}\\ \text{Inorganic.}\end{cases}$$
Exocardial.

Endocardial murmurs are those produced within the heart, and exocardial those upon its surface. Endocardial murmurs always occur at a definite time in the cardiac cycle, and have usually their point of maximum intensity at definite situations on the chest wall according to their place of origin. When a murmur is associated with one of the cardiac valves or orifices, the place where it is loudest heard usually corresponds to the position of one of the auscultatory cardiac areas. An endocardial murmur may be synchronous with one of the normal cardiac sounds, and so almost drown it, or the murmur may entirely replace a normal sound. Exocardial murmurs, on the other hand, do not usually correspond to any definite point in the cardiac cycle, and their points of maximum intensity are often not in the position of any of the cardiac areas.

Endocardial murmurs of organic origin, when once present, do not vanish except in a few instances, whereas it is characteristic of exocardial murmurs that sooner or later they disappear. For further differences between endocardial and exocardial murmurs, see p. 109.

Endocardial Murmurs.—At each valve two murmurs may be produced, one due to obstruction to the normal blood-flow, and the other to regurgitation through the valve. Sometimes the regurgitant murmur is produced by the blood leaking through a rent in one of the cusps of the valves.

When the presence of a murmur has been determined, it is best to investigate the following points in the order given below. If this practice be followed with regard to the first three points, the observer is far less likely to make a mistake as to the cause of the murmur.

1. Place of maximum intensity.
2. Direction of propagation.

3. Rhythm, or the period in the cardiac cycle in which the murmur occurs.
4. Character of the murmur.
5. Intensity of the murmur.

1. *Place of Maximum Intensity.*—By paying attention first of all to the position on the chest wall where the murmur is heard loudest, the examiner is more likely to accurately determine the seat of production of the normal sound than if he first attempt to ascertain its rhythm. A murmur having its origin at one of the valves or orifices is usually heard loudest at the corresponding cardiac area. There are, however, a few exceptions to this. An aortic regurgitant murmur is often loudest heard over the lower end of the sternum, or over the fourth and fifth intercostal spaces just to the left of the sternum, and sometimes as far out as the apex. Again, a mitral regurgitant murmur is sometimes loudest just below the pulmonary area.

2. *Direction of Propagation.*—Each valvular murmur is propagated in a definite direction, which will be described under their various headings. As a rule, the murmur is conducted in the direction the blood is flowing at the time of its production.

3. *Rhythm of the Murmur.*—Each murmur of valvular origin occurs at a definite period in the cardiac cycle. Murmurs arising during the ventricular systole are spoken of as *systolic*, and those arising during the diastole are called *diastolic*. Diastolic murmurs may be early, mid, or late, according to the time of their production during diastole. A late diastolic murmur occurring during the auricular systole is termed *presystolic*. To ascertain the rhythm of a murmur, it is usually easy to time it by observing the apex-

beat or by feeling the carotid pulse during auscultation.

4. *Character of the Murmur.*—A murmur may be soft, blowing, rough, rasping, whistling, musical, etc. As a general rule, murmurs which arise from obstruction or stenosis are rough in character, while those due to regurgitation or incompetence are soft and blowing.

5. *Intensity of the Murmur.*—The intensity of a murmur varies considerably. This depends partly upon the nature of the lesion, but chiefly upon the strength of the cardiac contractions, except in cases of aortic regurgitation. If a murmur be loud, it does not necessarily mean that the amount of disease of the valve is great. A murmur which is scarcely audible is often an indication of far greater mischief than a loud murmur. A murmur may disappear altogether when cardiac compensation is beginning to fail, as is sometimes seen in mitral stenosis.

Mitral Regurgitation.—The murmur of mitral regurgitation is by far the most common of all murmurs. It is heard loudest at the cardiac apex, and is conducted outwards into the axilla, and can often be heard posteriorly near the inferior angle of the left scapula. The murmur is systolic in time, accompanying or replacing the first sound. Usually the intensity of the murmur is greatest at first, and then gradually diminishes, but sometimes it is of the same intensity throughout. It is generally low-pitched and blowing in character. It is sometimes musical, at other times rough, but rarely very harsh. The pulmonary second sound is usually accentuated, and the apex-beat displaced downwards and to the left. The right ventricle may become enlarged, so that the area of cardiac dullness may be increased upwards, and may extend to the right of the sternum. The regurgitation may be caused by a diseased condition of the mitral valve, due to an acute endocarditis, either of rheumatic or other microbic origin, or to a more chronic condition, in which the valves and the chordæ tendineæ become thickened and shrunken. It may also be due to dilatation of the left auriculo-ventricular opening, or to dilatation of the left ventricle, in which case the chordæ tendineæ and the papillary muscles become too short to allow of the closure of the valves. During each ventricular contraction the auriculo-ventricular orifice diminishes in size, but if the contractions be feeble, then the size of the orifice may not be sufficiently reduced, so that regurgitation takes place through it.

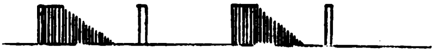


FIG. 17.—DIAGRAM OF THE MURMUR OF MITRAL REGURGITATION.

Mitral Stenosis.—The murmur of mitral stenosis or obstruction is loudest over the mitral area, and is often best heard a little above, and internal to, the apex-beat. The murmur is usually localized to a small area, and is not propagated in any definite direction. The murmur is caused by the blood being forced through the stenosed mitral valves. The two forces which produce this are the contractions of the walls of the left auricle and of the right ventricle. The suction action of the left ventricle during its diastole is probably not sufficient in itself to cause the murmur, but simply helps in the work of the left auricle and right ventricle. The presystolic murmur of mitral stenosis occurs during the end of the ventricular diastole, and corresponds to the systole of the left auricle. The murmur is, as a rule, rough, and increases in intensity up to the first sound, which is usually slapping or thumping in character. A mid-diastolic murmur sometimes occurs in mitral stenosis. This may be the only murmur present, but there may be a presystolic murmur as well, resulting in two distinct murmurs during the ventricular diastole. These two murmurs may be fused into one, when the contractions of the right ventricle and left auricle are vigorous. The mid-diastolic murmur is probably due to the previous contraction of the right ventricle increasing the blood-pressure in the lungs and left auricle, and so forcing the blood through the stenosed mitral valves. The mid-diastolic murmur varies slightly in its situation in the ventricular diastole, and this may depend upon the time when the force of the contraction of the right ventricle makes itself felt on the left side of the heart. This murmur in consequence may become an early or late diastolic murmur. When the force of the contractions of the left auricle begins to fail, the presystolic murmur often disappears. In mitral stenosis there may therefore be a presystolic murmur, a mid-diastolic murmur, mid-diastolic and presystolic murmurs, or a murmur which occupies almost the whole of the ventricular diastole. With all these murmurs the first sound at the apex is usually slapping or thumping in character. This alteration in the first sound may be present without any of the above-mentioned murmurs, and is in itself very characteristic of mitral stenosis. In some cases the second sound is reduplicated at the cardiac apex, while in others—and this is in the majority of the cases—it is inaudible. The second pulmonary sound is accentuated. A presystolic thrill is usually present at the apex, and the apex-beat is not displaced, as the left ventricle is not enlarged. There may also be indications of enlargement of the right side of the heart. The murmur may be accompanied by a mitral systolic murmur, as regurgitation often occurs through the stenosed orifice.

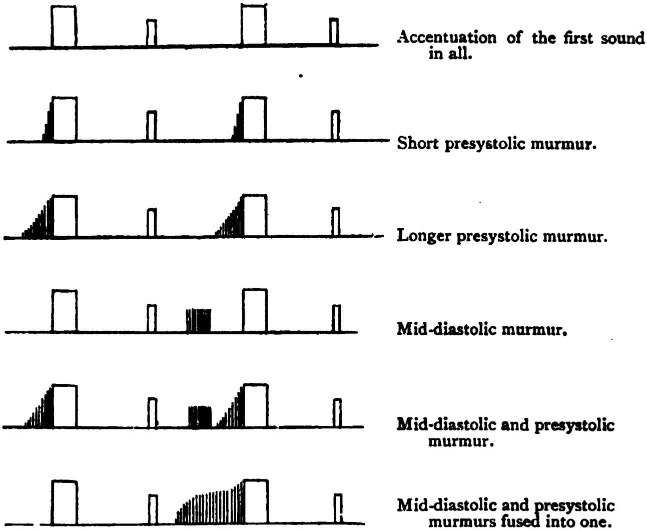

Accentuation of the first sound in all.
Short presystolic murmur.
Longer presystolic murmur.
Mid-diastolic murmur.
Mid-diastolic and presystolic murmur.
Mid-diastolic and presystolic murmurs fused into one.

FIG. 18.—DIAGRAM OF THE MURMURS OF MITRAL STENOSIS.

Aortic Obstruction.—The murmur produced by aortic obstruction is usually loudest over the aortic area, and is propagated upwards into the vessels of the neck. When the murmur is loud, it may be heard nearly all over the præcordia. It occurs at the commencement of ventricular systole, and the murmur may replace or obscure the first sound. It is usually loud and somewhat rough, and is accompanied very frequently by a systolic thrill, which is best felt in the second right intercostal space close to the sternum. A systolic murmur over the aortic area is of frequent occurrence, but is rarely caused by stenosis of the aortic orifice. The murmur is usually due to a progressive sclerosis of the aortic valves, whereby they become thickened, rough, and rigid. Vegetations on the semilunar valves produce a systolic murmur. A similar murmur also occurs in atheroma, dilatation, or aneurysm of the ascending portion of the arch of the aorta. On account of the thickening and contraction of the aortic cusps, there is frequently aortic regurgitation as well. The second aortic sound is often muffled, and sometimes inaudible, as the rigidity of the valves prevents them closing suddenly in the normal manner. If the second sound be loud, it points to the murmur arising in the aorta, in consequence of atheroma, dilatation, or aneurysm. Marked hypertrophy of the left ventricle takes place, so that the apex-beat is displaced downwards and outwards, but chiefly downwards.

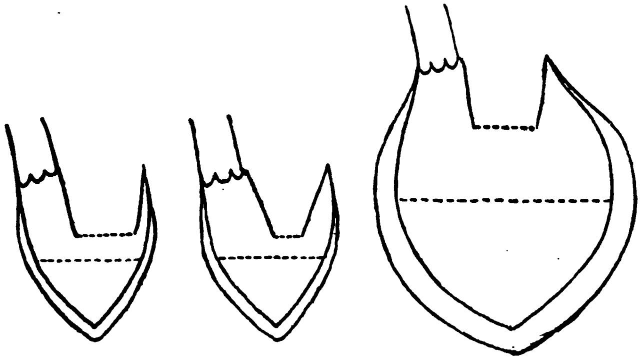
Aortic Regurgitation.—The murmur due to aortic regurgitation is the most characteristic and certain of all cardiac murmurs. The point of maximum intensity of the murmur varies in position. It may be loudest in the aortic area, but often the point of greatest intensity is a little to the left of the sternum at the lower border of the third costal cartilage. The murmur is conducted downwards along the left border of the sternum, and also outwards towards the cardiac apex. It is diastolic in time, and replaces the normal second aortic sound. The intensity of the murmur is greatest at first, and then gradually diminishes. It is usually blowing in character, low-pitched, occasionally musical, but rarely harsh. As a result of aortic regurgitation, the left ventricle becomes dilated and hypertrophied, with displacement of the apex-beat downwards. The ‘water-hammer pulse,’ or *Corrigan's* pulse, is associated with this condition.

A double murmur is often heard over the arteries in aortic regurgitation. The first murmur is produced when the vessels are suddenly distended with blood, and the second when the blood-pressure rapidly falls on account of the regurgitation. This double murmur is sometimes heard over the femoral artery, and when it occurs in this position it is spoken of as *Duroziez's sign*. *Capillary pulsation* is seen in aortic regurgitation, and is best demonstrated by placing a glass slide on the lower lip, which is everted, or by pressing the finger-nail so that the proximal half of it remains pink and the other is blanched. In cases of marked anæmia, capillary pulsation is often present.

A double aortic murmur, systolic and diastolic, is often present, and is spoken of as ‘see-saw’ or ‘to-and-fro’ murmur. This is caused by roughening, thickening, and contraction of the aortic valves, producing both obstruction and incompetence.

A murmur, presystolic in rhythm, is sometimes heard at the cardiac apex in aortic regurgitation. This is *Flint's murmur*, and is usually considered to be caused by the vibrations of the anterior curtain of the mitral valve, as it lies between the regurgitating blood-stream and that flowing into the ventricle from the left auricle. If this were the true explanation of Flint's murmur, it should occur early in diastole instead of being presystolic, as it invariably is. Another view is that the blood regurgitating through the aortic orifice lifts the anterior curtain of the mitral valve, and so obstructs the mitral orifice at the end of the ventricular diastole. Neither of these explanations seem to be sufficient to account for the murmur. In a normal heart the ratio of the diameter of the mitral opening to that of the left ventricle is about 1 to 2; in mitral stenosis, on account of the contracted mitral orifice, the ratio is about ½ to 2, the size of the left ventricle remaining the same. In this latter condition a presystolic murmur occurs, and it is probably this alteration in the ratio which produces it. In aortic regurgitation, although the diameter of the mitral orifice remains the same, yet the diameter of the left ventricle is greatly increased on account of its dilatation. The ratio between the diameter of the mitral opening to that of the left ventricle would probably be 1 to 4, or exactly the same ratio as occurs in mitral stenosis. There would be a relative mitral stenosis when the size of the mitral opening is compared with that of the left ventricle. The two conditions, therefore, may be similar, although the one is on a larger scale than the other; and as the altered ratio of these two diameters produces in mitral stenosis a presystolic murmur, it is very probable that the same ratio, although the factors are on a larger scale, would produce in aortic regurgitation Flint's murmur, which is also presystolic in time. A presystolic murmur is sometimes present without any aortic regurgitation, and without mitral stenosis, but always with an enlarged left ventricle; and this seems to point to the regurgitation of the blood through the aortic valves as not taking any direct part in the production of the murmur. Speaking generally, if a presystolic murmur be present with the apex-beat within the mammary line, it is always due to mitral stenosis; with the apex-beat external to this, it may be Flint's murmur, and produced as described above.

The following diagrammatic drawings of the heart are constructed in order to show the probable mode of production of Flint's murmur :



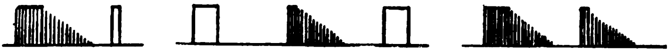
Normal Heart. Ratio of diameter of mitral valves and diameter of left ventricle, about 1 to 2.

Mitral Stenosis. Ratio about ½ to 2. Presystolic murmur.

Dilated Left Ventricle. Ratio about 1 to 4; same proportion as in mitral stenosis. Presystolic murmur (Flint's).

FIG. 19.—DIAGRAM TO EXPLAIN THE ORIGIN OF FLINT'S MURMUR.

The following is a diagrammatic representation of the murmurs of aortic obstruction and regurgitation :



Aortic obstruction. Aortic regurgitation. Double aortic.

FIG. 20.—DIAGRAM OF THE MURMURS OF AORTIC OBSTRUCTION AND REGURGITATION.

Tricuspid Regurgitation and Stenosis.—Murmurs produced by disease of the tricuspid valve are rare. The point of maximum intensity of tricuspid murmurs is in the tricuspid area at the lower end of the sternum. These murmurs are usually localized over a small area, and are rarely audible at the cardiac apex. The murmur of tricuspid regurgitation is systolic in rhythm, and is not very frequently heard, although dilatation of the tricuspid orifice is very common. In this condition the veins in the neck are distended, and pulsation is observed in the jugular veins, and also in the liver, which becomes enlarged from passive congestion. The murmur of tricuspid stenosis is presystolic in rhythm. These murmurs are rarely present without valvular disease of the left side of the heart.

Pulmonary Obstruction and Regurgitation.—Murmurs due to disease of the pulmonary valves are very rare. Their point of maximum intensity is in the pulmonary area. The pulmonary obstructive murmur is systolic in rhythm, and is almost always due to congenital stenosis of the pulmonary orifice. The murmur is propagated upwards and outwards towards the left shoulder, and may be associated with a thrill in the second left intercostal space close to the sternum. A systolic murmur in the pulmonary area is nearly always of functional origin, and occurs in chlorosis and other forms of anæmia. A pulmonary regurgitant murmur is still more rare, and is diastolic in rhythm.

Congenital Malformations of the Heart.—The most frequent congenital malformation is pulmonary stenosis, and the murmur produced by this has been described already. With this malformation, the foramen ovale is often patent, and this may give rise to a murmur, due to the differences in pressure in the right and the left auricle. The murmur is loudest at the base of the heart. Patency of the ductus arteriosus is associated with a loud, harsh murmur, with its maximum intensity in the second intercostal space just to the left of the sternum. It is systolic in rhythm, and is often accompanied by a systolic thrill. A defect in the interventricular septum may also give rise to a systolic murmur, with its maximum intensity in the upper half of the præcordia. A continuous murmur, varying in intensity at different points of the cardiac cycle, is sometimes heard in congenital heart disease. In some cases of congenital malformation no murmur is audible. The differential diagnosis of congenital from acquired cardiac diseases may give rise to considerable difficulty. The following are the chief points in diagnosis:

1. Congenital murmurs are usually of greater intensity at the base of the heart than elsewhere, and are not conducted in the recognized direction of murmurs due to acquired lesions.
2. Diastolic murmurs are rarely congenital in origin.
3. Loud murmurs, with normal size of the heart, are usually due to congenital defects.
4. When the area of cardiac dullness in young children is increased, and the increase is chiefly to the right of the sternum, the condition is more likely to be congenital in origin.
5. Other signs of congenital heart disease may be present, such as marked cyanosis, clubbing of the fingers, considerable under-development of the child, and a great increase in the number of red cells in the blood.

Multiple Murmurs.—Multiple murmurs are common, on account of the great frequency of combined valvular lesions. Double murmurs in the aortic area, due to regurgitation and thickening of the aortic valves, and at the cardiac apex in cases of mitral stenosis and mitral regurgitation, are the most common. The mitral and aortic valves may be affected together, and when this is the case the more usual combination in adults is mitral regurgitation with thickening of the aortic valves.

Aortic regurgitation and mitral regurgitation are also frequently found coexisting. Aortic obstruction with mitral stenosis, and aortic regurgitation with mitral stenosis, are rarely found combined. Tricuspid regurgitation is usually secondary to lesions of valves on the left side of the heart.

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Hæmic Murmurs.—Hæmic murmurs occur in the various forms of anæmia without any organic disease of the heart. They are audible over all the auscultatory areas in the following frequency: pulmonary, mitral, tricuspid, and aortic areas. The pulmonary area is the one over which a hæmic murmur is by far the most frequently heard. The murmur is usually loudest a little to the left of the pulmonary area, and is conducted outwards and upwards towards the left shoulder. It is louder when the patient is lying down than when in the erect position. It often increases in intensity when the patient turns over to the right side, and becomes less when in the prone position. Hæmic murmurs are generally blowing in character, and are always systolic in rhythm. They may be very loud. When a loud pulmonary hæmic murmur is present, pulsation may be felt in the second and third left intercostal spaces close to the sternum, and this is especially found to occur in cases of exophthalmic goître. A hæmic murmur over the mitral area is not nearly so common, and is probably due to temporary incompetence of the mitral valve, or to some functional derangement of the contractions of the walls of the left ventricle. A systolic murmur is occasionally audible at the apex in nervous patients, and is not due to any organic disease. This murmur has been termed the ‘bruit de consultation.’ Sometimes a systolic murmur is produced at the cardiac apex by the heart compressing the overlying lung against the chest wall, and forcing the air out of it. Such a murmur varies in intensity with the respiratory movements. Over the tricuspid area a hæmic murmur is very rare, and over the aortic area it is rarer still.

Various theories have been advanced in order to explain the mode of production of the pulmonary hæmic murmur. *Naunyn's* theory supposes that the murmur is due to mitral regurgitation, and that the vibrations are conducted to the chest wall through the left auricular appendix. This would explain the position of the maximum intensity of the murmur being slightly to the left of the pulmonary artery. If, however, the murmur were caused by mitral regurgitation, accentuation of the second pulmonary sound should be present, and this is rarely found to occur. Another view of the production of the murmur is that it is due to dilatation of the conus arteriosus and the pulmonary artery. Often the superficial area of cardiac dullness is found to extend up to the third left costal cartilage when this murmur is present, and so supports the supposition that the conus arteriosus is dilated.

Dilatation of the pulmonary artery beyond the pulmonary orifice is often given as an explanation of the origin of the pulmonary hæmic murmur. If the conus arteriosus is dilated as well, the pulmonary artery may arise from the right ventricle at a different angle than in a normal heart. When the patient is in the erect position the weight of the heart would tend to straighten out this angle, and also to reduce any dilatation of the pulmonary artery, and if such a condition exist, it would explain the waning of the murmur when the patient stands up.

Russell's theory that the murmur is due to pressure on the pulmonary artery by a dilatation of the left auricle can no longer be accepted, as dilatation of the auricle in no other condition produces a pulmonary systolic murmur. Probably other factors help in the production of the murmur, such as a lowered viscosity of the blood, which would accentuate any vibrations which may be present. Increased volume of the blood, as is found in chlorosis (Haldane and Lorrain Smith), and increased rapidity of the blood-flow, may also play some part in its production.

Hæmic murmurs may be very difficult to distinguish from those due to organic disease of the heart, but the following considerations will help in the diagnosis. The hæmic murmur is always systolic in rhythm, and when heard at the base of the heart, on the left side of the sternum, its point of maximum intensity is usually external to the pulmonary artery. The loudness of the murmur is no guide, for a hæmic murmur may be extremely loud. The presence of anæmia and the coexistence of a *bruit de diable* help greatly in the diagnosis. Whatever be the position of the murmur, the absence of all other evidence of organic disease of the heart, such as cardiac enlargement, accentuation of the second pulmonary sound, etc., points to it being a hæmic murmur. Endocardiac murmurs remain, whereas hæmic murmurs tend to disappear.

Exocardial Murmurs.—Exocardial murmurs are caused by the friction produced between the roughened pericardial surfaces in pericarditis. Murmurs, similar in some respects, are produced by the roughened pleural surfaces in a localized pleurisy in the neighbourhood of the heart. Pericardial murmurs are localized to the præcordia, and their points of maximum intensity are usually at the base of the heart on the left of the sternum, and over the right ventricle. They do not correspond to any of the cardiac areas, and are often only audible over a small portion of the præcordia. The murmurs are generally heard over the base firstly, but when the pericarditis has become general, these abnormal sounds are sometimes very loud, and may be heard all over the præcordia. There is often a pericardial thrill or fremitus felt in this condition. The murmurs are not propagated in any definite direction. They do not correspond definitely with any period of the cardiac cycle, but are usually of a 'to-and-fro' character, being more distinct during systole than diastole. Although they correspond in rhythm to the action of the heart, yet they are not usually synchronous with the commencement of systole or diastole, like endocardial murmurs, but more often occur after the beginning of each normal cardiac sound. The murmurs are nearly always double, and sometimes they are audible during the whole of the cardiac cycle, forming a continuous 'to-and-fro' murmur. At other times the murmur may be heard during the end of systole and overlapping into diastole, there being no interval in the abnormal sound during these two phases of the cardiac cycle.

Pericardial murmurs are rough, grating, rasping, or grazing in character; they are never musical. The sounds give to the ear the impression of superficial origin, and their intensity is often modified by the position of the patient, and is usually increased by pressure on the chest wall with the stethoscope. The intensity of the murmur is sometimes increased at the end of deep inspiration, and should this occur the condition is due to pleuro-pericardial friction. The murmur may vary considerably from day to day in intensity, pitch, and position, and even during the examination of the patient.

It may be audible even when there is a considerable amount of effusion into the pericardium, but when the pericardial surfaces are completely separated the murmur disappears, and returns as the fluid is absorbed. This redux friction, as it is called, gradually disappears.

When the friction sound is due to a pleurisy in the neighbourhood of the heart, and not to pericarditis, deep inspiration will increase the intensity of the sound. If the patient be instructed to hold his breath, the pleuritic friction sound will be greatly diminished in intensity, or completely disappear. The pericardial friction sound does not change when the breath is held or when a deep inspiration is made. The murmur, however, is sometimes increased in intensity at the end of deep inspiration, when it is due to pleuro-pericardial friction.

When pericarditis is present, the action of the heart often becomes irregular and tumultuous, and where there is pericardial effusion the cardiac sounds become faint and distant, and quite inaudible if the effusion be great.

The following table compares the physical signs of pericarditis with effusion and those of cardiac dilatation:

Pericarditis with Effusion.	*Cardiac Dilatation.*
Inspection.—Often bulging of præcordia, especially in children. Apex-beat, if visible, raised—usually invisible. Impulse feeble, and later absent.	Apex-beat usually visible, wavy, and diffuse; displaced downwards and outwards. Impulse feeble. There may be considerable bulging of the præcordia in children.
Palpation. — Confirms the above. Impulse usually not palpable. Friction fremitus over base.	Confirms the above. Impulse usually palpable.

Percussion.—Area of cardiac dullness triangular, with base below. Rotch's sign. Apex of dullness may reach very high, and varies slightly with patient's position. Dull area posteriorly in large effusions. Cardiac dullness to left and downwards, beyond apex-beat when present. Ewart's first rib sign.	Area of cardiac dullness varies in shape according to the cavity most dilated. Does not reach so high—highest in mitral stenosis. Superficial cardiac dullness does not extend to the left or downwards beyond the apex-beat.
Auscultation.—Cardiac sounds distant, muffled, often absent. Double friction murmur over base. May be no endocardial murmurs.	First sound similar to second, short and clear. Endocardial murmurs usually present. No friction murmur.

Murmurs arising in Blood Vessels—*Murmurs in Arteries.*—Over arteries near the heart, such as the common carotid, even in health, two sounds may be heard upon auscultation. The first corresponds to the expansion of the artery, and the second is the second aortic sound, which is conducted along the artery. By pressure with the stethoscope upon an artery over which no sounds are usually audible, a murmur may be produced which corresponds in time to the expansion of the vessel. The pitch of such a murmur increases with the pressure used. Systolic murmurs are often conducted into the arteries of the neck. In aortic regurgitation a double murmur is sometimes heard over the femoral artery, and is spoken of as Duroziez's sign. In atheroma of the arch of the aorta a systolic murmur may be heard over the aortic area ; it may also be audible just to the left of the spines of the vertebral column, between the scapulæ. In such a condition there is usually some dilatation of the arch of the aorta. Systolic murmurs are heard over aortic aneurysms, and are loudest where the aneurysm is nearest the chest wall. Pulsation may be seen, and a thrill felt even before there is any bulging on the surface. When there is a distinct tumour, the pulsation and thrill are generally well marked, unless the aneurysm be filled with clot. A murmur may be heard over any aneurysmal swelling. Over the subclavian artery a murmur is sometimes heard in phthisis, due to the contraction of adhesions which have formed between the pleura and the artery. Such a murmur varies in intensity with the movements of respiration. A patent ductus arteriosus often produces a loud murmur. Over an aneurysmal varix a murmur, usually continuous, and varying in intensity in different parts of the cardiac cycle, is practically always present. Over very vascular tumours murmurs are often heard, and in consequence such tumours may be very difficult to distinguish from an aneurysm when they are situated in a position where an aneurysm may occur.

Murmurs in Veins.—In chlorosis chiefly, and in all forms of anæmia usually, a continuous humming murmur may be audible over the internal jugular vein. This is the *bruit de diable*, and is probably caused by a change in the calibre of the vessel as it passes through the cervical fascia. The stethoscope must be placed very lightly over the vein so as not to produce a murmur artificially, or it may be placed over the sterno-clavicular articulation, where pressure will not affect the murmur. The murmur is nearly always louder on the right than on the left side. It is increased in intensity when the patient's head is turned to the opposite side ; it is also louder when the patient is standing than when she is lying down. The *bruit de diable* is increased in intensity during inspiration, and is sometimes louder during the ventricular diastole. It is also increased by slight pressure with the stethoscope. When the murmur is very loud, a thrill may be felt over the vein.

In tricuspid regurgitation systolic murmurs are occasionally heard over the jugular veins. Sometimes murmurs occur over the superior vena cava and the innominate veins, and occasionally over dilated thyroid veins.

Venous murmurs are heard over the anterior fontanelle in infants. Murmurs are sometimes audible over the occiput, and are supposed to be produced in the torcular Herophili.

PART III

EXAMINATION OF THE ABDOMEN

CHAPTER I

GENERAL CONSIDERATIONS OF THE EXAMINATION OF THE ABDOMEN

In order to examine the abdomen, the patient should be in the recumbent position, and the head and shoulders should lie on a low pillow in order to relax the abdominal muscles. This can be further accomplished by having the knees drawn up, so that the soles of the feet rest upon the couch or bed. The whole of the patient's back must lie comfortably on the bed. This point should be noticed, for the patient is liable to arch his back, and so make the abdominal walls rigid. It is absolutely essential for a satisfactory examination that the abdomen should be fully exposed to view. Under certain conditions the abdomen may be examined while the patient is placed in other positions, such as the lateral recumbent, genu-pectoral, erect, and sitting positions. These will be described when such positions are necessary or useful in making the examination.

Inspection of the Abdomen.—It is very important to examine the abdomen first by a thorough inspection, for by its means very valuable information can be obtained. The position that the patient assumes when lying on the back must be noticed. The patient may lie quite comfortably and flat on the bed, but, on the other hand, he may assume an unnatural position in order to relieve abdominal pain, by not lying quite straight, or by having one or both legs drawn up.

The general appearance of the abdomen will be noticed. Instead of the normal contour there may be general fullness or prominence, local fullness and even bulging, and general retraction.

General fullness or prominence has been described by Professor Wyllie as generally due to ' fat, fluid, flatus, fœtus, or fæces '; but it must be remembered that a new growth, even without the presence of ascites, may be a cause of general prominence of the abdomen. In general fullness it is important to notice whether the enlargement is chiefly in the antero-posterior or in the transverse diameter when the patient is in the recumbent position. If the enlargement be in the transverse diameter, so that the front of the abdomen is rather flattened, while the sides bulge, then the condition is nearly always due to ascites, as the fluid gravitates to the lowest parts. The swelling of the abdomen may not be quite uniform all over, for it may appear a little more prominent in one place than another. This lack of uniformity in the enlargement is seen chiefly when the prominence is due to a new growth, tuberculous peritonitis, pregnancy, and chronic intestinal obstruction.

Local fullness or bulging may be observed in any part of the abdomen. It may be due to conditions in the abdominal wall, such as a localized muscular contraction, tumour, or abscess ; by a hernia into the abdominal wall; and by some swelling within the abdomen. The local fullness must be carefully observed as to its relation to the various regions of the abdomen, and as it is seldom by inspection alone that the nature of these localized swellings can be determined, their description will be deferred until the palpation of the abdomen is considered.

General retraction of the abdominal walls is seen in most diseases which cause wasting. It occurs in inanition, especially when it is due to œsophageal obstruction. It is found also in diseases of the brain, as in tuberculous meningitis, and to this condition of general retraction the terms *boat-shaped, scaphoid,* and *carinated abdomen,* have been applied.

Movements of the abdominal walls must be carefully noticed upon inspection. The movements which occur are (1) respiratory, (2) pulsatory, and (3) peristaltic.

1. In health during quiet breathing the anterior abdominal wall bulges out with inspiration, and falls with expiration. The reverse occurs in paralysis of the diaphragm. For other indications of paralysis of the diaphragm, see p. 37.

In peritonitis the movements of the abdominal walls during respiration become greatly diminished or cease altogether, and on inspection of the abdomen any diminution in these movements must always be carefully observed. The movements of respiration may cease over the whole of the abdomen in general peritonitis, but in a less diffuse inflammation of the peritoneum the movements of only a portion may be interfered with. Thus the upper part of the abdomen may move well on respiration, and the lower part not at all. In a localised peritonitis a still smaller area over which the respiratory movements are affected may be seen. The abdominal walls may move very slightly, or not at all, when there is great distension, either from an accumulation of fluid or from a large tumour.

Certain abdominal tumours are affected by the movements of respiration, and may be seen to change their position, descending with inspiration and ascending with expiration. All tumours attached to the diaphragm, liver, and spleen move in this manner with respiration. A tumour of the stomach usually moves with respiration, especially when situated at the pylorus, as this part is in such close relationship with the liver. Tumours of the kidney only move very slightly. None of the other abdominal tumours are affected by the respiratory movements. In persons with thin abdominal walls the lower edge of an enlarged liver or an enlarged spleen may be seen moving with respiration.

2. Pulsations of various kinds may be seen on inspection of the abdomen, and they are found chiefly in the epigastrium. They may be divided into two groups—pulsations synchronous with the apex-beat, and pulsations occurring just after the apex-beat.

Pulsations synchronous with the apex-beat are caused by (*a*) the heart pulsating in the epigastrium, due to hypertrophy or dilatation of the right ventricle, and also to anything which depresses the diaphragm or displaces the heart towards the right. If the action of the heart be excessive, its pulsations may be transmitted to the epigastrium. (*b*) Pulsations of the liver in the epigastrium, which, when they are synchronous with the apex-beat, are simply transmitted from the heart.

Pulsations occurring just after the apex-beat are caused by (*a*) venous pulsation of the liver, due to engorgement of the right side of the heart, with passive congestion of the liver; (*b*) pulsation of the abdominal aorta in nervous individuals, especially women; the pulsations are not limited to the epigastrium, but can be traced down to the umbilicus; (*c*) pulsations of an abdominal aneurysm; (*d*) a tumour transmitting the pulsations of the abdominal aorta.

3. Peristaltic movements may be visible because the abdominal walls are very thin, or because the peristaltic movements are excessive. Occasionally the abdominal walls are so thin, especially in infants suffering from marasmus, that almost every movement of the intestines is noticed, and even when there is no movement the shape and position of the intestinal coils may produce a 'pattern' on the abdominal wall. Peristaltic movements may be seen in connexion with the stomach or intestines. If the movements be not present, they can often be made to appear by flicking the surface with the fingers. Peristaltic movements can often be seen in a distended stomach, and it is important to observe in which direction the waves travel. In the normal stomach they travel from left to right, but if there be any pyloric obstruction they may be seen to travel from right to left (retroperistalsis). The peristaltic waves of the transverse colon should travel from right to left, so that if there be no pyloric obstruction the direction of the waves will indicate whether they occur in the stomach or the transverse colon. In chronic intestinal obstruction the walls of the bowels undergo hypertrophy, so that the coils of intestines, in which peristaltic movements may be seen, form a 'pattern' on the abdominal parietes.

Abnormal Appearances of the Skin of the Abdomen.—The skin may be smooth and shining from distension, or it may be wrinkled and dull from wasting. Œdema may occur in the abdominal walls, so that they pit on pressure. It is always greatest in the most dependent regions, and usually associated with dropsy in other parts of the body, and often with ascites. Striæ albicantes indicate former distension of the abdomen, and appear as white and glistening lines in the epidermis. Scars due to previous surgical operations may also be present. Prominence of the ensiform cartilage often points to previous enlargement of the abdomen of long duration. Pigmentation of the skin may be observed under many conditions, and is most marked in Addison's disease. The so-called 'linea nigra' of pregnancy occurs in the middle line between the pubes and the umbilicus, but becomes more marked after delivery. The abdominal parietes are often very flaccid in women who have borne many children, and appear very thin.

Any dilatation of the superficial veins must be noted and the direction of the blood-flow in them. In obstruction of the inferior vena cava, and also in portal obstruction, the superficial veins in the abdominal walls are dilated to provide collateral circulations. In the former case the collateral circulation is through the inferior epigastric veins to the superficial veins of the thorax, and by this path to the superior vena cava. In portal obstruction the collateral circulation is through the round and suspensory ligaments to the superficial veins of the epigastric and mammary systems—the accessory portal system of Sappey. A bunch of veins around the navel—the so-called 'caput medusæ'—occurs in portal obstruction, but is by no means commonly present.

Many skin eruptions may be found on the abdomen, and some of those of the specific fevers are more marked in this region than elsewhere, as is the case in typhoid fever. The skin over a localized peritonitis which has passed on to suppuration may be red and œdematous.

The observer should always be careful to examine for hernia.

The appearance of the umbilicus must be noticed, as to whether it is depressed, stretched out flat, or bulging. Normally the umbilicus is depressed, and if the abdominal walls be very thick this depression is well marked. It may be stretched out flat, and even bulging, when there is abdominal distension, and this appearance of the abdomen chiefly occurs in ascites. The umbilicus may bulge on account of a small umbilical hernia, and this is especially common in infants; an umbilical hernia may be so large in adult life as to cause a huge pedunculated swelling. Besides the umbilical hernia there may be other ventral herniæ, of which there are (1) divarications of the recti, (2) ventral hernia after wounds, (3) epigastric hernia in linea alba above umbilicus, and (4) lumbar hernia.

Discharges occur from the umbilicus, which may consist of pus, urine, or fæces. The pus may depend upon suppuration in urachal or vitelline cysts, or it may be due to a vitelline duct tumour. Sometimes it is due to a suppurative peritonitis, which is nearly always of tuberculous origin. A discharge of urine is rare, and depends upon a urachal fistula. Fæces may discharge from the umbilicus on account of a patent vitelline duct, or a fistula with the bowel.

Palpation of the Abdomen.—Constant practice is required in order to become efficient in the palpation of the abdomen. By the skilful use of palpation more valuable information can be ascertained than by any other means of diagnosis. The patient must be in the recumbent position, as described above. The abdominal muscles may be further relaxed by directing the patient to breathe quietly with his mouth open, or by getting him to talk during the examination. It may be very difficult to get the abdominal walls sufficiently soft to make a satisfactory examination, but it is quite useless to remonstrate with the patient, for the more his attention is drawn to the matter, the worse is it likely to become. Sometimes, even with the greatest patience, it is impossible to palpate thoroughly; but, whenever it is necessary, the administration of a general anæsthetic will allow of a thorough examination of the abdomen. When a localized muscular contraction of the abdominal wall simulates an intra-abdominal tumour, the administration of an anæsthetic will clear up the point, as a tumour due to muscular contraction will disappear at once.

In palpation of the abdomen the observer must be careful to have his hands thoroughly warm. First examine with one hand by laying it flat on the abdomen, and then palpate all over by pressing gently with the fingers ; the movements of the hand should be chiefly at the metacarpo-phalangeal joints. The examination must not be made with the tips of the fingers, but the whole of the palmar surface of the fingers must be used. The whole of the palmar surface of the hand must be kept in contact with the abdomen, and not raised from it during the examination. During the end of inspiration, when the abdominal walls should be most relaxed, by suddenly pressing with the fingers of the hand which is lying on the abdomen more information may be gained, as a deep-seated tumour may be felt. This is spoken of as ' dipping.' The abdomen must be palpated all over in this manner, and it is best to begin in those regions where no pain is complained of, and where no swelling is obvious. Further information can always be obtained by palpation with both hands at the same time, and such a mode of examination should never be omitted. Bimanual palpation should be used in the lateral regions of the abdomen, and is of special use in examining the kidneys. One hand is placed behind, between the last rib and the crest of the ilium, and pressed upwards, while the other is placed on the abdominal wall in front. In this way the structures between the two hands can be readily palpated.

The *tension and resistance* of the abdominal walls are the first things noticed upon palpation. The abdomen in health feels soft, elastic, and slightly doughy, and palpation should cause no tenderness nor contraction of the abdominal muscles. The abdomen feels tense when it is distended with anything abnormal, and the tension is usually greatest when it is due to ascites. The resistance of the abdominal walls may be increased, and this may be either general or local. The resistance is greatly increased all over the abdomen, and the muscles of the abdominal walls become rigid and board-like in cases of general peritonitis. A local increase in resistance is often due to a localized peritonitis, so that rigidity in any part of the abdomen must be carefully observed.

Tenderness should not be caused by palpation over a normal abdomen, but when it is present its position must be carefully noted. Usually increased local resistance and tenderness go together, as the one is dependent upon the other. The tenderness may be distributed all over the abdomen, as in general peritonitis, and even drawing the hand lightly across the surface is painful to the patient. Often there are acutely painful spots on the abdominal wall, depending upon visceral disease, which has produced a cutaneous hyperæsthesia.

Such a painful spot occurs in the peripheral distribution of those spinal nerves whose centres in the spinal cord are connected with the sympathetic nerves supplying the affected organ.*

When a *tumour* is felt, it is necessary to determine first of all whether it be inside the abdomen or in the abdominal wall. If the abdominal wall can be moved about over the tumour, it must be intra-abdominal; but if it cannot be moved about over it, the tumour is not necessarily in the abdominal wall, for it may be attached to it by peritoneal adhesions. Tumours in the abdominal parietes are unaltered in position by the movements of respiration, or by change in the posture of the patient. It is often possible to get the fingers slightly under any tumour in the abdominal wall. To diagnose between a tumour within the abdomen and in its wall is usually quite easy, and it is only rarely there is any difficulty. Occasionally localized contractions of the abdominal muscles have been mistaken for other tumours; such swellings would become more prominent on the patient raising his head, whereas an intra-abdominal tumour would become less obvious.

The position of the tumour within the abdomen must next be carefully noted, and an attempt be made to ascertain the organ from which it arises. The differential diagnosis of abdominal tumours will be dealt with later. The shape and size of the tumour must be discovered, if possible, and the nature of its surface determined as to whether it is smooth, irregular, or nodular. It is very important to ascertain whether the tumour is movable or not by means of palpation, and also whether it moves upon respiration. All tumours attached to the diaphragm, liver, or spleen move with respiration. A tumour of the pyloric end of the stomach usually moves freely, while one in the greater curvature moves in a less degree. Tumours of the kidney move only slightly. None of the other tumours are affected by the movements of respiration, as already mentioned.

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* James Mackenzie, 'Pain,' *Brain*, part xcix.

During palpation of the abdomen, gurgling is often provoked, but is of no diagnostic value. Splashing is sometimes heard over the stomach, and is only evidence of dilatation of the organ when it occurs some hours after the swallowing of food, and when it is elicited over a larger surface of the abdomen than that which corresponds to the normal gastric area.

Mensuration of the Abdomen.—A measurement of the girth of the abdomen at the level of the umbilicus may be made upon the first examination; any subsequent measurements will give definite information of increase or decrease in the size of the abdomen. Mensuration of the abdomen is chiefly made use of in ascites and in tuberculous peritonitis.

Percussion of the Abdomen.—Percussion of the abdomen is carried out in a similar manner to that of the thorax. The note over the normal abdomen is tympanitic, except over the liver, spleen, distended urinary bladder, and gravid uterus, where it is dull. The pitch of the tympanitic note depends upon the size of the underlying air cavity and the tension of its walls. The pitch, therefore, of the tympanitic note must vary considerably from time to time over the same organ, yet some indication of the size of a hollow viscus can be obtained by percussion. By carefully noticing any change in the pitch of the tympanitic note the boundaries of a hollow organ, such as the stomach, may be mapped out. It is important, however, to remember that the neighbouring hollow viscera may give a note of the same pitch at that particular time, and so a wrong conclusion may be drawn. Dullness on percussion may occur in any part of the abdomen on account of an accumulation of fæces. Dullness may be due to the presence of ascites, pus, blood, thickened omentum, etc., and is found over an abdominal tumour if no bowel containing gas intervene between it and the parietes. When any abnormal dullness is obtained, it is important to ascertain if the area of dullness shifts with alterations in the position of the patient. Shifting dullness can only occur with free fluid in the peritoneum.

The areas of hepatic and of splenic dullness, which are normally present, disappear when there is free gas in the peritoneal cavity.

When fluid is present in the peritoneum, a *fluid thrill* may be provoked. It is obtained by placing one hand over the lumbar region on one side, and by flicking with the first finger of the other hand over the opposite lumbar region. In this way a thrill is transmitted, which is very distinct. It is as well to get an assistant to place the inner edge of his hand firmly along the middle line of the patient's abdomen, so as to prevent any vibrations of the abdominal wall being transmitted.

The *hydatid thrill* is sometimes obtained over a hydatid cyst. All the fingers of the left hand should be placed flat over the cyst, and the middle finger percussed sharply ; the thrill is felt after the stroke has been given. A similar thrill may occasionally be elicited over a parovarian cyst and over ascitic fluid.

Auscultation of the Abdomen.—Auscultation of the abdomen is not much employed. It is chiefly used in combination with percussion, which mode of examination is spoken of as 'auscultatory percussion.' Auscul-

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tation helps in the diagnosis of pregnancy, for over a suspected uterine enlargement the fœtal heart sounds and uterine souffle may be heard. The fœtal heart sounds are usually best heard at a point half-way between the umbilicus and the left anterior superior iliac spine. By auscultation, aneurysmal bruits may be heard, and friction sounds detected from the roughening of peritoneal surfaces or by the presence of lymph.

Auscultatory percussion is chiefly employed for mapping out the size of hollow organs, but it can only define that portion of the organ which is in contact with the abdominal wall. Auscultation is performed by means of a binaural stethoscope over the centre of the organ, and percussion is made by flicking the abdomen with the first finger of either hand. Percussion is performed along radiating lines from the stethoscope, and the points observed where the pitch of the tympanitic note changes will indicate the size of the hollow organ below. Instead of percussing with the fingers, two coins may be used. One coin is laid on the abdomen and struck with the other. Auscultation is performed as before while the coins are moved about, in order to define the points where the note changes. A modification of auscultatory percussion can also be carried out by means of a straight wooden stethoscope. The earpiece is placed against the observer's forehead, instead of over the ear, and this leaves the two hands free for percussing the abdomen.

CHAPTER II

EXAMINATION OF THE ABDOMEN IN DISEASES OF THE PERITONEUM

THE affections of the peritoneum, whose physical signs are about to be considered, are :

- Acute peritonitis
  - General.
  - Localized.
- Tuberculous peritonitis.
- Ascites.

By the examination of the abdomen, not only is the presence of a peritonitis ascertained, but an attempt is made to find out the cause of the peritonitis. By physical examination alone, however, it is often impossible to determine the cause of the peritonitis, and it is only by the help of the history of the malady that an accurate conception of the condition can be obtained.

Acute General Peritonitis.—When the condition is well established, the patient lies with his legs drawn up, and often with the hands above the head, in order to relax the abdominal muscles as much as possible. There is usually great restlessness. On inspection, the abdominal walls are generally sunken during the earlier stages of the malady, but later, when meteorism or tympanites appears, the abdomen becomes more prominent. In order to protect the inflamed parts, the abdominal walls are held rigid, and appear board-like, and all abdominal movements of respiration cease, while the upper thoracic movements are exaggerated. On palpation, the rigidity of the abdominal walls is made more apparent, as the rigidity becomes greater when they are manipulated. There is usually very great tenderness, and the skin becomes so hyperæsthetic that the patient shrinks from the gentlest palpation, and often cannot bear even the bedclothes to rest upon the abdomen. On percussion, a tympanitic note is usually obtained all over the front of the abdomen; the normal hepatic and splenic dullness is often greatly diminished, and sometimes obliterated. Tympanites occurs on account of the paralysis of the walls of the intestines. The diminution in the area of hepatic and splenic dullness may be due to tympanites, in which case the liver and the spleen are often displaced upwards. On the other hand, it may be due to the presence of gas in the peritoneal cavity, the result of perforation of the bowel. Tympanites may completely obliterate the hepatic dullness in the mammary line, but in the axillary line some dullness always persists. Gas in the peritoneum may obliterate all hepatic dullness, and if the patient be turned on the left side, a resonant note may be obtained over the liver in the right axillary line. There may be fluid also in the peritoneal cavity, sufficient to produce dullness in the flanks. This dullness shifts with the position of the patient, for if he roll over to one side, the flank which is uppermost becomes tympanitic on percussion. In the sitting position the whole of the dullness in the flanks may vanish. As the length of time during which the peritonitis has existed becomes greater, the rigidity of the abdominal walls, the pain, and the hyperæsthesia of the skin have a tendency to decrease, so that the abdomen becomes more rounded, its walls less rigid, and even the abdominal movements of respiration return. Usually the abdomen is distended from meteorism, and as this increases the percussion note becomes markedly tympanitic, and the areas of hepatic and splenic dullness diminished.

General peritonitis may suddenly occur in a patient who is already exhausted, collapsed, or in a semiconscious state, and produce very few physical signs. This is most frequently seen in the peritonitis caused by the perforation of a typhoid ulcer, so that, unless a very careful watch be kept upon the patient, this disaster may take place without the condition being diagnosed. The patient becomes even more collapsed, and there is a sudden fall in his temperature. The abdominal walls may not become rigid, but usually dullness appears in the flanks, and diminution or absence of the liver dullness occurs.

Localized peritonitis is well illustrated by that variety which results from inflammation of the vermiform appendix. In this condition the signs of a localized peritonitis are observed in the right iliac region. Inspection of the abdomen in the early stages often produces a negative result, but the diminished respiratory movements of the abdominal walls over the affected area may be noticed. On palpation, however, the rigidity of the abdominal walls over the affected area is at once appreciated, and is even more easily recognized when the corresponding sides of the abdomen are compared. When the condition is less acute, a doughy resistance, accompanied by tenderness on deep palpation, is often felt over the affected part. This tenderness occurs most commonly at *McBurney's point*, which is situated at the intersection of a line drawn from the umbilicus to the anterior superior iliac spine, with a second line, corresponding to the outer edge of the right rectus muscle. When an appendicular abscess is present, a tumour may be felt in the right iliac region. Over the swelling there is tenderness, but when the abscess has been present for some time, and thick adhesions formed around, the tenderness may not be so well marked. When suppuration has occurred in a localized peritonitis, the skin above may be œdematous and red. After the patient has recovered from the attack, a disposition to contraction in the muscles of the right side of the abdomen, and a tenderness on pressure, may continue for some time when palpation is performed in the right iliac region. On percussion, the note over a localized peritonitis may be impaired only slightly; but if there be a tumour due to the formation of an abscess, the note over it is dull, unless some portion of the bowel intervene between it and the parietes. It must be remembered that an accumulation of fæces would also produce a dull note.

A localized peritonitis in other parts of the abdomen gives similar physical signs to those described above—viz., diminished movement, rigidity, and tenderness.

Tuberculous peritonitis may be acute or chronic. The acute form, in which the disease rarely lasts more than two months, may occur as a part of a generalized tuberculosis, and often gives very few definite physical signs. Tumidity is usually present, while pain and tenderness occur over the abdomen, not necessarily in any special region nor constant in position. In many cases the only sign of this form of tuberculous peritonitis is ascites, unaccompanied by pain or any other local condition. Tympanites is often a marked feature.

Chronic tuberculous peritonitis may be divided into (1) the chronic caseating or ulcerous form, and (2) the fibrous form. In the chronic caseating form the abdomen, upon examination, is usually found to be swollen, and tender, and to have irregularly distributed areas of increased resistance upon palpation. The superficial veins, especially in the lower half of the abdomen, are usually prominent. Often ascites occurs in an early stage of the disease. The abdomen increases in size, and the tenderness and pain become more severe as the morbid changes advance. The size of the abdomen is due at first to tympanitic distension, but later is increased by the exudation which occurs. There are not often signs of free fluid in the peritoneum, for the exudation is confined by adhesions between the intestines in imperfectly communicating loculi. A fluid thrill may be obtained, but shifting dullness is not often present. Later in the disease the swelling of the abdomen is more irregular ; it has a characteristic doughy sensation, and tumours can be felt. These tumours often vary in position and size from day to day. A sausage-shaped tumour may be felt lying transversely in the region of the umbilicus or a little higher, and is due to puckering and contraction of the great omentum.

The fibrous form may have commenced as an acute tuberculous peritonitis or as the chronic caseating, and hence in its earlier stages may have the physical signs of either variety. When the fibrous form is well advanced, the abdomen is retracted and flattened over the whole of its surface. This condition is spoken of as the boat-shaped or carinated abdomen (p. 116). The costal margins, pubes, and the anterior superior iliac spines stand out prominently. The abdominal walls do not move well, but there is usually little tenderness on palpation. There is a sensation of resistance all over the abdomen, and often tumours can be felt, especially if the fibrosis be more advanced in certain regions than others.

Ascites.—Fluid, if free in the peritoneum, gravitates to the most dependent parts. When the patient is in the recumbent position, the anterior part of the abdomen is flattened, unless there be a large quantity of fluid, while the sides bulge. This appearance is best marked when there is a moderate amount of effusion. If the erect position be assumed, the prominence is greatest in the hypogastric region. On percussion, a dull note is obtained over the fluid. When the fluid does not fill the whole of the abdomen, its upper limit is more or less horizontal; hence, if the patient be lying down, there is an area of resonance around the umbilicus, varying in size according to the amount of fluid present. When a small amount of fluid is present dullness is obtained in the flanks only; when more occurs, the dullness reaches higher, and is found over the lower part of the abdomen; and as the fluid increases, the resonant area in the centre of the abdomen becomes gradually diminished in size. There is nearly always some resonance round the umbilicus as the intestines float up to the surface. The fluid moves its position with that of the patient, so that a *shifting dullness* is present. When the patient lies on one side, the flank which is uppermost, and which gave a dull note before, becomes resonant, while there is an increase in the height of the dullness in the other flank. If the amount of fluid be small, it can usually be detected by instructing the patient to lie on one side, and then percussing the flank which is lowest. If dullness occurs there, and disappears when the patient lies on the opposite side, to reappear in the opposite flank, the presence of fluid is certain. In still smaller collections of fluid a dull area is found around the umbilicus when the patient is placed upon his hands and knees, on account of the fluid gravitating to this region, which is then the lowest. In ascites a *fluid thrill* occurs, and is a very important physical sign. It can be obtained while the patient is lying on his back, by placing one hand over the lumbar region on one side, and by flicking the opposite lumbar region with the first finger of the other hand. A thrill is felt, which is the impulse of the undulating wave thus set up when it reaches the opposite side of the abdomen. It is as well to get an assistant to place the edge of his hand firmly along the middle line of the patient's abdomen, so as to prevent any vibrations of the abdominal wall being transmitted (p. 125). The umbilicus appears flattened out and stretched by the accumulation of the fluid, and in an extensive effusion may even bulge.

Ascites may be overlooked when the fluid is small in amount ; but when large, an ovarian cyst is practically the only condition likely to be mistaken for it. The differences in the physical signs between an ascites and an ovarian cyst are :

Ascites.	*Ovarian Cyst.*
Inspection.—Enlargement symmetrical, with bulging in flanks in recumbent position. Umbilicus usually flattened out and may protrude. Greatest circumference usually at level of umbilicus.	Enlargement asymmetrical. Greatest swelling in antero-posterior diameter, and not in the flanks. Greatest circumference is below umbilicus. No protruding of umbilicus.
Palpation.—Fluid thrill from side to side. No aortic pulsations felt.	Fluid thrill is circumscribed, corresponding to the limits of the tumour. Aortic pulsations may be felt.

Percussion.—In recumbent position dullness in flanks, with resonance over centre of abdomen. Change of patient's position alters the distribution of the dullness. When standing, upper limit of dullness is slightly concave in front.	In recumbent position, dullness in front, with resonance in the flanks. Changes of position do not alter the distribution of the dullness. Upper limit of dullness is convex in front.

Causes of Peritonitis.—Very often the cause of a peritonitis cannot be determined by physical examination alone. The position of the greatest tenderness and the loss of movement of the abdominal wall are sometimes very deceptive signs in giving an indication of the cause of a general peritonitis; for occasionally that part of the abdomen at which the disease commenced becomes anæsthetic first, and so the tenderness and loss of movements may not be as well marked there as elsewhere. Again, in a peritonitis due to a perforated gastric ulcer the signs of involvement of the peritoneum are sometimes more marked in the lower part of the abdomen than in the epigastrium, so that the condition may be mistaken for appendicitis, or some inflammation due to disease of the pelvic organs. This is brought about by the contents of the stomach gravitating into the pelvis, and so causing the peritonitis to be more acute there and in the lower part of the abdomen than in the region of the stomach. In this condition, and in most other forms of peritonitis, it is only with the help of the subjective symptoms, and by a careful investigation of the history of the case, that the cause of the peritonitis can be determined. In a more localized peritonitis, on the other hand, the position of the physical signs indicates in many cases the cause of the inflammation, so that a diagnosis may be made by means of the physical examination alone.

In examining a case of peritonitis, the causes which may give rise to the condition must always be kept in mind. The causes may be classified under the following heads :

1. Peritonitis caused by infection from the intestines : Perforation and ulceration of the stomach, intestines, and vermiform appendix ; hernia ; intestinal obstruction ; volvulus ; intussusception ; strangulation by bands ; cancer of the gut ; disease of gall-bladder and bile-ducts.

2. Peritonitis caused by infection from without : Diseases of the pelvic organs ; diseases and injuries of abdominal parietes ; inflammation spreading through diaphragm and from retro-peritoneal organs.

3. Peritonitis caused by the pneumococcus of Fraenkel.
4. Peritonitis of doubtful origin.
5. Tuberculous peritonitis.

CHAPTER III

EXAMINATION OF THE STOMACH AND INTESTINES

The Stomach.

Examination of the Stomach by Inspection.—In a well-nourished person the stomach in health, even when distended, shows little or no swelling upon inspection of the abdomen. It is only occasionally that the shape and size of the stomach can be determined by inspection alone, but if the abdominal walls be thin an oval swelling can sometimes be seen in the epigastrium, when the stomach is distended, without any disease being present. Dilatation of the stomach, or *gastrectasis*, occasionally produces in a thin patient a well-marked prominence, and in such a condition the greater curvature of the stomach may be fairly easily seen. The greater curvature is sometimes indicated by a groove running down diagonally to the right from the left costal cartilage. In *gastroptosis*, or displacement downwards of the stomach, the prominence which sometimes occurs in this condition may lie in, and even extend below, the umbilical region, and the outline of the lesser curvature may also be visible. The outline of the lesser curvature is best seen when the light comes from the foot of the bed, and the outline of the greater curvature when it comes from the head.

The outlines of the stomach can be made more visible by inflating the viscus. This can be performed (1) by passing a stomach-tube, and by pumping air through it into the stomach by means of a Higginson's syringe, or (2) by administering an alkaline carbonate, followed by an acid, so that carbonic acid gas is given off in the stomach.* Inflation of the stomach is also of assistance in examination by palpation and percussion. The contra-indications to inflation are: feebleness of the patient, recent hæmatemesis, any signs of gastric ulcer or growth of stomach, and disease of the heart.

Peristaltic movements of the stomach may be seen, and especially occur in chronic conditions in which the stomach walls have undergone hypertrophy. Sometimes when movements do not seem to be present they may be elicited by manipulation, or by flicking the skin in the epigastric region. The peristaltic movements travel from left to right, and may be so marked that 'a tumour the size of an orange may rise in the cardiac portion, and slowly and sinuously travel towards the pylorus' (Clifford Allbutt). Sometimes the movements do not appear as continuous waves travelling along the stomach, but are represented by a swelling suddenly appearing over a portion of the stomach, and then subsiding, to reappear over another portion. Peristaltic movements from left to right do not necessarily mean that there is pyloric obstruction, but a reverse direction of the movements—*i.e.*, from right to left—is very significant of obstruction at the pylorus. Care must be taken not to mistake peristaltic movements of the transverse colon for these, as they also pass from right to left.

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* Sodii Bicarb., 80 grains, Acidum Tartaricum, 60 grains.
Sodii Bicarb., 7 grammes, Acidum Tartaricum, 6 grammes (Von Ziemsen).
Sodii Bicarb., ʒii., Acidi Tartarici, ʒiss. (Saundby).

A tumour of the stomach only rarely produces a prominence visible upon inspection. Such a prominence will be found to alter its position with the movements of respiration. When the tumour is at the pylorus it ascends and descends to a greater degree with the movements of respiration than when it is situated in the greater curvature.

Examination of the Stomach by Palpation.—Palpation over the stomach in disease may elicit tenderness, which may be distributed all over the gastric area or confined to a very small portion of it. In gastric ulcer the area over which the pain is felt is often so small that the patient may point with the finger to one particular spot. In an acute gastritis the tenderness may be so severe and the abdominal wall over the gastric area become so rigid upon palpation, that an acute localized peritonitis may be suspected to be present. When there be any tenderness, hold the patient in conversation while palpating the abdomen, and notice if then the tenderness be still present. The abdominal walls will not become any less rigid if there be peritonitis, but in other conditions there will be some relaxation.

A tumour of the stomach is usually due to carcinoma, and may be detected by palpation, but the absence of a palpable tumour does not exclude cancer being present. Tumours of the lesser curvature or of the cardiac end of the stomach are usually not palpable, as they lie under cover of the liver and ribs. The most common tumour is carcinoma of the pylorus, and occurs about four times as frequently as any other form of gastric carcinoma. The pylorus in health cannot be felt, so that if this part can be made out by palpation it is almost certain to be diseased. A tumour in the neighbourhood of the pylorus may be of the stomach, transverse colon, duodenum, liver, gall-bladder, or pancreas. A pyloric tumour not only moves with respiration, but may be moved from side to side upon palpation, when it is not attached to the neighbouring organs. With a pyloric tumour the stomach is dilated, and not usually in any of the other conditions. A gastric tumour is made more obvious by inflation of the stomach, whereas a pancreatic tumour, as it lies behind the stomach, disappears and is less likely to be palpable,

The chief differences between tumours of the pylorus and the head of the pancreas are :

Pylorus.	*Head of Pancreas.*
Tumour sometimes freely movable upon palpation. Position usually affected by the movements of respiration. No jaundice. Dilatation of the stomach. No ascites.	Tumour more deeply situated and fixed. Not affected by the movements of respiration. Usually jaundice. No dilatation of the stomach. Often ascites.

When the carcinoma is situated in the anterior wall of the stomach or along its greater curvature, it is more readily detected upon palpation than in any other position. The growth is more easy to move about by manipulation ; it does not travel up and down to such a marked degree with the movements of respiration, but alters its position with the degree of distension of the stomach. Such a tumour may feel hard and irregular, and be tender on palpation. Sometimes it appears as a large mass running transversely across the abdomen above the umbilicus, when it may be mistaken for a hepatic enlargement, for thickened and puckered omentum as in tuberculous peritonitis, for a tumour, cyst, or abscess in connexion with the pancreas, or for a new growth of the transverse colon.

Splashing or succussion sounds depend upon the presence of fluid and gas in a cavity, and so may be produced in the stomach. They cannot usually be elicited during health, but sometimes they occur during the first three hours after a meal without any disease of the stomach. If the splashing be obtained later than this when the stomach should be empty, it indicates dilatation of the viscus, and especially so when it is found to occur over a wider area than that of the normal stomach. To examine for succussion, the observer should stand on the right side of the patient, who should be in the recumbent position, and place his right hand over the lower ribs in the left axillary line, and the other over the epigastrium. The hands should then be sharply and suddenly thrust inwards, either alternately or together. Another method is to percuss along the middle line of the abdomen from below upwards, with the tips of the fingers brought together in a line, as in immediate percussion (p. 55). If this be done fairly forcibly, the succussion sound may be obtained when the stomach area is reached. By both of these methods the splashing is usually heard without the aid of a stethoscope, and in the former method the splashing is sometimes felt.

Examination of the Stomach by Percussion.—By means of percussion an attempt is made to ascertain the outlines of the stomach. The outlines of the stomach may be very difficult to determine, because it is often impossible to distinguish between the resonance of the stomach, colon, and small intestines. The tympanitic note of the stomach varies from time to time, and depends upon the size and shape of the viscus, upon its contents—whether solid, liquid, or gas—and upon the degree of distension. When the distension has extended to a certain point, a metallic and consonating quality may be given to the note, which makes it even more difficult to define the gastric boundaries. In examining the stomach an attempt should always be made to ascertain its outlines by percussion, but it must be remembered that by this method of examination only that portion of the stomach which is in contact with the abdominal wall can be defined. The extent of the gastric area which is mapped out depends chiefly upon the size of the stomach, and only slightly upon changes in the neighbouring viscera, both in the abdomen and thorax, which might be expected to overlap or expose more of the surface of the stomach.

Percussion must be performed while the patient is in the recumbent position ; it should be done lightly, and should be commenced over the stomach close to the left costal margin in the epigastrium, or in the left seventh or eighth intercostal spaces in the mammary line. By this means the stomach note is obtained. Next, in order to determine the gastric boundaries, percussion should be performed from various parts of the abdomen and the left side of the chest towards the stomach, and the points marked where the stomach note commences. This should then be confirmed by percussing from the stomach area to over the neighbouring organs. The point at which the note changes in the latter method of percussion can often be more accurately determined by auscultatory percussion (p. 126).

The portion of the stomach which is in contact with the abdominal wall is bounded above by the left lobe of the liver and the lower margin of the left lung ; on the left it is bounded by the anterior edge of the spleen, while below it corresponds to the greater curvature of the stomach. The important boundary to determine first is that of the greater curvature. In health it does not reach below the umbilicus, and in the normal stomach the greatest vertical diameter of the gastric resonance is from 4 to 5½ inches in men, and about 4 inches in women.* No gastric resonance should be obtained to the right of the middle line. In dilatation of the stomach the lower border may reach far below the umbilicus, even to the pubes in extreme cases, and the gastric resonance extend to the right of the middle line. The boundary between the stomach and the left lobe of the liver can as a rule be ascertained quite easily by percussion from the stomach to the edge of the liver. The position of this boundary is of little value in considering diseases of the stomach, as it is more likely to depend upon enlargement or diminution of the liver, which would cover up or expose more of the anterior surface of the stomach. This boundary cannot be made out when free gas is present in the peritoneum. By percussion in a similar manner the boundary between the stomach on the one hand, and the left lung and spleen on the other, is ascertained. The percussion outline between the stomach and the left lung runs from the sixth costal cartilage in the mammary line to the ninth rib in the mid-axillary line. The stomach, however, reaches up to the level of the fifth rib in the left mammary line, but cannot be percussed out as high as this on account of the left lung lying in front. That portion of the stomach which lies behind the lower ribs and costal cartilages on the left side forms a triangular area, called *Traube's space.* It is an area over which a tympanitic

* Pacanowski: 10 to 14 cm. in men; 10 cm. in women.

note is obtained, bounded above by the anterior margin of the left lobe of the liver and the lower edge of the left lung, below and to the left by the anterior margin of the spleen, and below and to the right by the left costal margin. The resonance in Traube's space may be due not only to the underlying stomach, but also to intestines which may be situated in this area. In dilatation of the stomach the gastric resonance is not bounded by the anterior margin of the spleen, but can be made out far beyond this, round the left side, even to the back of the chest.

The size of the area of gastric resonance depends not only upon the size of the stomach, but also upon the condition of the neighbouring organs. By contraction of the liver in atrophic cirrhosis, or by retraction of the lung by fibrosis, more of the stomach is exposed, and so the area of resonance is increased. An enlarged liver or an effusion in the left pleura covers up more of the stomach, and thereby may diminish the area of gastric resonance.

Even after the greater curvature of the stomach is found to be below the umbilicus, it does not follow that the organ is dilated, because the stomach may be displaced downwards, and the condition known as *gastroptosis,* before referred to, be present. It is important, therefore, if such a condition be suspected, to attempt to define the lesser curvature by percussion. The cardiac end of the stomach remains fixed while the pylorus moves downwards, so that there may be little, if any, gastric resonance in the epigastrium. Inflation of the stomach makes it more easy to ascertain by percussion the position of the lesser curvature, and also of the pylorus, and so helps to distinguish between gastroptosis and gastrectasis.

Mensuration may be employed to determine the size of the stomach, but this method is obviously not of much use, on account of the many fallacies which may occur. A stiff sound is passed down the œsophagus into the stomach until the greater curvature is reached. Normally the sound will not pass more than 24 inches, measured from the teeth, but in cases of dilatation it may pass as much as 28 inches. Mensuration will indicate only a considerable amount of dilatation of the stomach, such as can more readily and with less discomfort to the patient be determined by other modes of examination already described.

Gastro-diaphany, or the transillumination of the stomach by means of a small electric lamp at the end of a flexible tube passed down the œsophagus, is rarely employed and of little practical use.

Auscultation of the stomach is usually only performed in combination with percussion. Auscultatory percussion is valuable in determining the size of the stomach, and the method of its employment has been described already (p. 126). Care must be taken to percuss only lightly, or otherwise the gas in the neighbouring hollow viscera begins to vibrate. By auscultation the succussion or splashing sounds may be heard, but usually the aid of the stethoscope is not required for this purpose. Sometimes a sissling sound is heard, which is caused by the bursting of bubbles of gas generated by fermentation taking place in the contents of the stomach. The sound is similar to that given off from a bottle of aerated water when first opened. Deglutition sounds can also be heard over the stomach, and sometimes peritoneal friction sounds. The heart sounds are often transmitted with great clearness, and with an additional metallic quality, as the stomach when distended with gas acts as a resonator.

The Intestines.

The examination of the intestines by inspection, palpation, and percussion has already been partly described on p. 127 *et seq.* On percussion over the intestines, the note is tympanitic, but areas of dullness may be present, due to the accumulation of fæces.

Peristaltic movements may often be seen without any disease of the intestines when the abdominal walls are very thin, and especially are they seen in infants who have greatly wasted. Under such circumstances there may be no distension of the abdomen. Coils of intestines with peristaltic movements appear outlined on the abdominal walls in cases of intestinal obstruction, and in these conditions the abdomen is distended.

On examination by palpation many tumours may be discovered which have their origin in the intestines. It must not be forgotten that accumulation of fæces in the intestines, and chiefly in the large intestines, may give rise to localized swellings in various parts of the abdomen. Fæcal masses lodged in the colon fill up the sacculi in its walls, and so may feel nodular on palpation. Often, however, they are quite smooth. They are usually of doughy consistence, but they may become hard from absorption of fluid. Fæcal masses are found most commonly in the cæcum, iliac colon, the hepatic flexure, and the transverse colon. Considerable pain may be experienced by the patient upon palpation over a fæcal mass, as sometimes the mucous membrane of the colon is inflamed, or even ulcerated (stercoral ulcers). In the right iliac region it may be difficult in some cases to distinguish between the swelling due to an accumulation of fæces and that occurring as a result of appendicitis.

Intestinal obstruction may be caused by—

1. Strangulation by bands:
    (*a*) Peritoneal adhesions; (*b*) omental adhesions; (*c*) Meckel's diverticulum; (*d*) normal structures—*e.g.*, vermiform appendix, Fallopian tubes; (*e*) mesenteric apertures.
2. Intussusception.
3. Volvulus.
4. Herniæ.
5. Stricture.
6. Tumours and foreign bodies within the bowel.
7. Pressure of tumours external to the bowel.
8. Fæcal accumulations.

In cases of intestinal obstruction with gradual onset the abdomen becomes more and more distended. The presence of visible peristaltic movements and visible coils of intestine points to there being a partial obstruction of long duration, as the walls of the bowel above the site of the obstruction have had time to undergo hypertrophy. The shape of the abdomen is often an indication of the position of the obstruction. When it exists in the iliac colon or rectum, the swelling may occupy the whole of the abdomen and become extreme. Usually the loins become very prominent, and also the regions of the iliac colon, transverse colon, and cæcum. In obstruction at the lower end of the ileum the small intestines above are distended, while the large intestines are empty, with the result that the central portion of the abdomen becomes protuberant. This is well seen sometimes when the patient stands up, for the abdomen then bulges more conspicuously in the middle line, especially between the umbilicus and pubes, while there is a distinct shrinking in of the loins, on account of the empty colon and the weight of the loaded small intestines drawing tight the abdominal walls on each side. When the obstruction is high up in the jejunum the protuberance is not nearly so marked, and is nearly always limited to the upper part of the abdomen. When there is pyloric obstruction the stomach only is distended.

Besides the increased sense of resistance and the finding of fæcal masses upon palpation, other tumours may be felt which are the cause of the intestinal obstruction. The condition may be due to an *intussusception* in which a definite tumour is found in over 50 per cent. of the cases (Treves). The tumour is usually in the line of the colon, and more often on the right side; a common situation is just below the liver. The tumour may not be well defined, but when it can be felt it is usually elongated and sausage-shaped, and very tender upon palpation. The tumour is dull upon percussion. The most advanced portion of the intussusception may be felt by rectal examination, and sometimes it protrudes from the anus. The other tumours, which may be felt, and which may be producing the obstruction, are new growths of the intestinal wall, causing stenosis of the bowel by encircling it, or interfering with the passage of the intestinal contents by their presence within the gut.

A swelling may also be detected in intestinal obstruction due to new growths and other tumours of the neighbouring viscera, and to foreign bodies within the bowel under certain conditions.

Tympanites.—Gases are normally present in the stomach and intestines, but when there is a considerable amount which causes distension of the bowel, then the condition is spoken of as *tympanites* or *meteorism.* The abdomen becomes enlarged and prominent, and gives a marked tympanitic note upon percussion.

Tympanites may be due to intestinal obstruction, but often occurs in many other conditions. It is present whenever there is loss of muscular tone of the intestinal walls, resulting in sluggish action of the bowels and fermentation of their contents. It may therefore occur in atonic dyspepsia, in chronic catarrh of the intestine, in acute peritonitis, and in lesions of the spinal cord. It is often very marked in typhoid fever. A lesser degree of tympanites occurs in hysterical patients. As one of the functions of the bile is to act as an antiseptic, tympanites is often found when the bile is prevented from entering the intestines, by obstruction of the common bile-duct. In rickets and in many forms of gastro-enteritis occurring in infants, tympanites is very often present, and the distension of the bowels may continue for so long a time as to cause a permanent enlargement of the abdomen. Great distension of the bowels is also associated with ascites, and with passive congestion due to cardiac disease. Tympanites may be so great as to interfere with the movements of respiration. This is brought about in two ways: The distended intestines impede mechanically the movements of the diaphragm, and also compress the lungs. Tympanites may interfere with the action of the heart, causing palpitation. When the tympanites is due to intestinal obstruction, the amount of the distension and its distribution may indicate the position of the obstruction. If the obstruction be in the iliac colon or rectum, then the tympanites may cause distension of the whole of the bowel above, and in consequence a uniform enlargement of the abdomen occurs. If, on the other hand, the obstruction be at the lower end of the ileum, then the small intestines only may be inflated, so that the swelling of the abdomen occurs chiefly in the central portion in the region of the umbilicus.

Examination of the Rectum.—It is very important in many diseases of the abdomen that the rectum should be examined, and so a short description of the method to be employed is given below.

In examining the rectum by the finger, the patient is placed in the lateral or semi-prone position, with the knees drawn up. The anus is first inspected by drawing apart the gluteal folds, when the presence of external hæmorrhoids, fistulæ, etc., will be noticed. To examine the rectum, if the patient be lying on his left side the right forefinger is employed; if on the right side, the left forefinger. The palmar surface of the finger used must always be towards the hollow of the sacrum, for by this means the finger can reach quite half an inch higher. The nail should be carefully trimmed and filled with soap, and the finger smeared with vaseline. If the patient be directed to bear down, the sphincter is relaxed, and the introduction of the finger is made more easy. The finger, having passed the anus, is directed slightly backwards and upwards. The whole of the inner surface of the rectum can be explored, and in favourable circumstances for about 4 inches.

'*Digital examination* of the interior of the ano-rectal canal will determine the presence of—

Internal piles.
Internal fistulous openings.
Simple, malignant, and granulomatous ulcers and new growths.
Strictures.
Intussusceptions and invaginations.
Foreign bodies.
Impacted fæces and scybala.'*

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* 'Diseases of the Rectum,' by F. Victor Milward.

CHAPTER IV

EXAMINATION OF THE LIVER AND SPLEEN

The Liver.

Examination of the Liver by Inspection.—When the liver is normal in size and position, the lower ribs in front appear symmetrical on the two sides, and the movements of the organ with those of respiration cannot be observed upon inspection. When, however, the liver is enlarged, a protuberance of the lower ribs on the right side may be seen, and the lower edge of the liver may produce a sharp line across the abdomen, which ascends and descends with the movements of respiration. In a general enlargement of the liver any swelling dependent upon it is usually seen below the right costal margin; but if the left lobe be chiefly affected, the prominence is more marked in the epigastrium. A tumour of the liver or a distended gall-bladder may produce a visible swelling, which moves up and down with respiration. When the liver is displaced downwards, it does not produce so frequently a visible prominence, as the organ may not be enlarged. If there be any uncertainty about the hepatic area being more prominent than the corresponding region on the left side, inspection from the feet will usually dispel all doubt. Pulsation of the liver may be transmitted to the abdominal walls, and the movements caused by it seen upon inspection.

Examination of the Liver by Palpation—*Methods.*—In examining the liver by palpation, an attempt should be made first to define its lower edge. In a healthy adult the lower edge cannot be felt in the right mammary line, except occasionally at the end of deep inspiration. In the epigastrium, however, the left lobe of the liver gives a sense of resistance to the palpating hand, but it is often impossible, even in this region, to feel the lower edge of the normal liver, on account of the thickness of the recti abdominis muscles. The liver in infants is larger in proportion to that of adults, so that it can usually be felt below the costal margin. In order to examine the liver by palpation, the patient should be in the recumbent position. It is best for the examiner to stand on the right side of the couch, and to use his right hand, which must be placed flat upon the abdomen just below and parallel to the right costal margin, external to the rectus abdominis muscle. If the hand be placed over this muscle, a septum in its sheath may be mistaken for the lower edge of the liver. The radial margin of the hand, with the thumb abducted, should depress slightly the abdominal wall below the costal margin, and the patient be told to take a deep breath. The edge of the liver may be felt to come down, and even pass under the hand. Sometimes the liver is so large that the examining hand when placed in this position lies over the anterior surface of the organ, and so is higher up than its lower edge. It is necessary, therefore, always to feel for the edge of the liver at different levels.

Another method of examining the edge of the liver is spoken of as *Glenard's procédé du pouce.* The patient should be in the same position as before, but the examiner should sit on the right side of the couch, facing the patient. The left hand is placed over the right hypochondriac and lumbar regions in such a manner that the hand passes round the side of the patient, and the fingers at the back press forward the two lowest ribs and the loin. The left thumb is abducted into such a position that it palpates the anterior abdominal wall in the right mammary line just below the costal margin. The other hand is placed transversely across the abdomen over the right iliac and hypogastric regions, with the fingers pointing to the patient's right. While employing firm pressure with the right hand, the fingers are moved round in an arc, so as to point towards the right costal margin. Some of the intestines are pushed up in this manner under the liver, which is already forced forwards by the fingers of the left hand. Upon the patient now taking a deep breath, the edge of the liver may be felt by the thumb of the left hand. This method is often very useful for examining the lower edge of the liver. An enlarged gall-bladder and the linguiform lobe known as Riedel's process may be detected readily in this way.

Sometimes when the liver is enlarged, and even reaching well down below the costal margin, it cannot be felt by the methods of palpation already described, on account of it being at some distance from the surface. This may occur when there is fluid in the peritoneal cavity. Under such conditions palpation by 'dipping' will often elicit the presence of the enlarged organ. This is performed by suddenly and forcibly pressing with the ends of the fingers over the liver, just below the costal margin, when the fingers will displace the fluid and come down upon the organ below. One hand only may be employed in this method of palpation, but it is more easy to perform by using both hands and keeping all the fingers in a line.

The character of the lower edge of the liver can be determined by palpation. The edge may be sharp and hard, or rounded and of normal consistency; it may appear as a smooth boundary, or it may be irregular from small or large nodules in it, or uneven in outline, on account of one portion of the liver having undergone changes in size more than another portion. The edge of the liver is occasionally found to be slightly everted. The fissure over the gall-bladder and that at the junction of the right and left lobes may be felt sometimes upon palpation.

The Character of the Surface of the Liver.—The surface of the liver may be smooth or irregular, and its character may be ascertained by palpation when the organ reaches below the costal margin. The liver is smooth in chronic venous congestion, fatty disease, amyloid disease, and unilobular cirrhosis; it is irregular in multilobular cirrhosis and in carcinoma. The irregularities may be small, and if associated with symptoms of portal obstruction, such as ascites and enlargement of the spleen, then the condition is probably one of multilobular cirrhosis (the hob-nail liver), although the organ in this form of cirrhosis is not, as a rule, enlarged, but is usually contracted. If the irregularities be large, and the nodules project below the edge, they are usually due to secondary deposits of carcinoma. The carcinomatous nodules are often described as being depressed in the centre, or *umbilicated*, but this characteristic is very difficult to ascertain by palpation. When a tropical abscess or a hydatid cyst is present a distinct tumour may be felt. The feeling of resistance upon palpation over the liver is of great importance. In uniform enlargement the resistance is greatest in amyloid disease; it is also increased in cirrhosis and in chronic venous congestion; in the fatty liver the increase in resistance is not so marked.

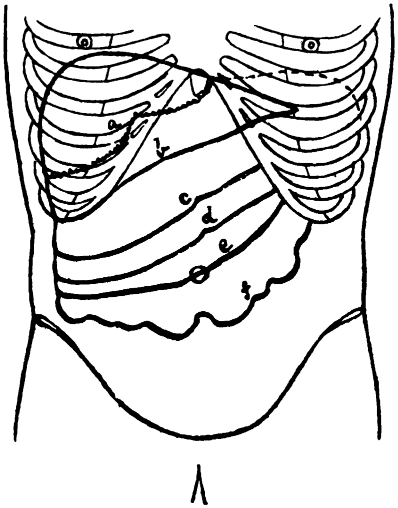

Fig. 21.—Relative Positions of the Edge of the Liver in Various Diseases of the Organ.

a, Multilobular cirrhosis. *b*, Normal. *c*, Unilobular cirrhosis. *d*, Fatty liver. *e*, Amyloid disease. *f*, Carcinoma.

The size of the liver varies greatly, but it must be remembered that it cannot be determined by palpation alone, as only the lower border can be defined, while its upper limit has to be ascertained by percussion. The position of the lower border may seem to indicate that the liver is enlarged, but the organ may be depressed, and its displacement downwards be the only cause for the edge being felt. The liver is increased in size in chronic venous congestion, fatty and amyloid disease, leucocythæmia, unilobular cirrhosis, and carcinoma, and may reach in some cases almost to the symphysis pubes. The liver is diminished in size in multilobular cirrhosis and in acute yellow atrophy.

The shape of the liver may be altered under many conditions. Tight-lacing alters its shape by compressing it from side to side, and so elongating it ; a deep longitudinal furrow is often produced on its anterior surface. It also displaces the liver downwards. The elongated right lobe may be mistaken for a floating kidney, but the former appears more superficial, and cannot be prevented from passing upwards during expiration. The causes of a uniform enlargement of the liver have already been given, but when the enlargement involves only a portion of the organ it may be due to tropical abscess, hydatid cyst, or carcinomatous growths. When any of these conditions are present, a distinct tumour may be felt, which may greatly alter the shape of the liver. The linguiform lobe of Riedel also gives the liver a curious shape. All tumours of the liver move with respiration.

Tenderness over the liver upon palpation may give very useful information. It is most marked in venous congestion and in all inflammatory affections of the liver, such as hepatic abscess, cirrhosis, perihepatitis, and suppurative cholangitis. In carcinoma of the liver tenderness is sometimes a prominent symptom, while at other times it may be absent. There is usually no tenderness associated with fatty or amyloid disease of the liver.

Pulsation of the liver is best recognized by palpation. Expansile pulsation of the liver is found in venous congestion with tricuspid incompetence, occurring with each beat of the heart, and immediately following the cardiac impulse. The pulsation may be very marked; but if it be only slight it can be best appreciated by placing one hand over the liver in front, and the other over the organ in the mid-axillary line. Other pulsations occur in the liver which are transmitted from the heart or from the abdominal aorta. They are not nearly so pronounced as in venous congestion, and have already been referred to under Pulsations in the Epigastrium, p. 117.

The gall-bladder cannot be felt unless it is enlarged. When it is distended it is pyriform in shape, and projects from under the right costal margin, opposite the costal cartilage of the ninth rib. This point is more conveniently found by considering it as on a line drawn from the right nipple to the umbilicus, or as just to the outer edge of the right rectus abdominis muscle. The distended gall-bladder is often tender on palpation, and rises and falls with the movements of respiration. It can also be moved from side to side, and it is sometimes possible to empty it of bile by long and firm pressure, and so cause the tumour almost to disappear. An enlarged gall-bladder may be distinguished from a floating kidney in that the former is more superficial and follows more closely the movements of respiration. Sometimes when gall-stones are present in the gall-bladder, crepitus may be obtained by the rubbing of the stones on each other. A history of biliary colic and the passage of gall-stones will help in the diagnosis.

Examination of the Liver by Percussion—*Methods.*—Percussion should be commenced over the right lung in the mammary line where the note is resonant, and carried down on to the liver. If light percussion be performed, the note is found to become absolutely dull in a healthy person at the level of the sixth rib. In the mid-axillary line the dullness commences at the eighth rib, and in the scapular line at the tenth rib. In the middle line in front the areas of cardiac and hepatic dullness blend. The line thus marked out round the right side of the chest is the upper boundary of the superficial or absolute hepatic dullness, and corresponds to the lower margin of the right lung. The upper surface of the liver reaches a higher level than this, and its highest point may be made out by heavy percussion, which should be commenced over the right lung in the mammary line in the second intercostal space, so as to get a good resonant note, and then should be carried downwards in each intercostal space until an impairment of the note is perceived. Percussion should then be repeated in a similar manner over each rib. The upper limit of the deep or relative hepatic dullness is thus marked out in the right mammary line, and usually corresponds to the fourth intercostal space. In the mid-axillary line the change in the note is perceived at the level of the seventh intercostal space, and in the scapular line at the ninth space on the right side.

The lower margin of the hepatic dullness is ascertained by percussion being commenced over the tympanitic abdomen and carried upwards. The lower margin is situated in the middle line in front, about a hand's breadth below the junction of the sternum and the ensiform cartilage; in the right mammary line it coincides fairly accurately with the costal margin; in the mid-axillary line it corresponds to the tenth intercostal space; and behind in the scapular line it blends with the dullness over the right kidney. The gall-bladder cannot in health be made out by percussion;

but if it be distended it may be detected by a dull area projecting from the lower margin of the liver. The dullness is generally continuous with the hepatic dullness.

The lower edge of the liver cannot always be satisfactorily determined by percussion, as there are various conditions which may cause a temporary difficulty in ascertaining its position. Distension of the intestines with gas may so enlarge them that they cover up the lower edge of the liver ; the area of dullness may therefore be diminished in tympanites. Accumulation of fæces in the transverse colon, or a large quantity of food in the stomach, gives a dull note upon percussion below the costal margin, and this may be confused with the dull note over the liver. A similar difficulty may arise when there is ascites ; also in cases of thickened omentum, or any new growth lying just below the liver. Rigidity or thickening of the anterior abdominal wall may make it difficult to map out the lower edge of the liver by percussion.

The average breadth of the hepatic dullness is from 2½ to 3 inches in the middle line in front, 4 inches in the right mammary line, and 4½ to 5 inches in the right axillary line. The area of the normal hepatic dullness alters slightly in size and position. The movements of respiration change the position of the liver, so that the hepatic dullness is depressed at the end of inspiration; the upper limit of the superficial hepatic dullness is lowered also by the expansion of the right lung, as the inferior margin of the lung comes down further in front of the liver during inspiration. Changes in the patient's attitude have some effect upon the position of the liver, for the organ is usually lower when the patient is in the erect than in the recumbent posture, and tends to move towards the side on which he may be lying.

On percussion over the liver, besides the dull note which is obtained, a *sense of resistance* is experienced by the finger which is acting as the pleximeter. The degree of resistance is increased whenever the liver is enlarged, as it is pressed more firmly against the chest wall.

The area of hepatic dullness may be increased or diminished in size, or altered in position, according to the size and position of the liver.

Increased Area of Hepatic Dullness.—The causes of an increase in size of the liver have been given already, and these produce a corresponding increase in the area of hepatic dullness, p. 154. In children the area of hepatic dullness is increased relatively in breadth, reaching higher up in the chest and descending below the costal margin. The liver is enlarged in rickets, and sometimes the deformities of the chest due to this disease also depress the organ. The breadth of the superficial area of hepatic dullness is greater when there is retraction of the right lung, as more of the liver is uncovered by the lung. There may be an apparent increase upwards in the hepatic dullness, which is not due to an enlargement of the liver, but to the dull note that is obtained over a consolidation at the base of the right lung, or over a pleural effusion on the right side. Sometimes a hydatid cyst increases the hepatic dullness above rather than below. A subdiaphragmatic abscess may give the impression that the liver is increased in size in an upward direction. An increase in size downward may be simulated by fæces in the transverse colon and by anything which produces a dull note on percussion below the costal margin.

Diminished Area of Hepatic Dullness.—Diminution in the size of the liver produces a smaller area of hepatic dullness, but the area of dullness is more usually diminished from other causes. The upper limit is lowered in pulmonary emphysema, as the enlarged lung not only depresses, but also covers up more of the liver. The area is diminished below by tympanites, and sometimes by the transverse colon slipping up and lying between the liver and the abdominal wall. The liver may be raised by an increase in the intra-abdominal pressure, as in cases of tympanites, ascites, and abdominal tumour, and in consequence the breadth of the hepatic dullness appears lessened because more of the anterior surface of the liver is covered by the right lung. The area of hepatic dullness may be greatly diminished, and even obliterated, by the presence of gas in the peritoneum. It is rarely obliterated from any other cause, for in all those conditions, however extreme they may be, which reduce the area of dullness, there is nearly always some dullness present in the mid-axillary line. Even when the liver is more overlapped by the lung than normally, and reduced in size from cirrhosis, it is very rare for the hepatic dullness to disappear in this region. A diminution in the area of hepatic dullness is more often due to conditions of the surrounding organs than to any decrease in the size of the liver itself. When the liver is reduced in size, as in multilobular or atrophic cirrhosis, and in acute yellow atrophy, the organ, as it becomes smaller, recedes from the anterior surface of the abdomen and lies in the posterior part of the concavity of the diaphragm, so that the place it should normally fill in front may be occupied by coils of small intestines and by the transverse colon, producing in consequence a very great diminution, and even absence, of hepatic dullness in the right mammary line.

Displacement of the Area of Hepatic Dullness.—There may be difficulty in distinguishing between displacement and an increase in the size of the liver. The organ may be displaced downwards in emphysema of the lungs, which not only depresses the position of the hepatic dullness, but also reduces it in the manner described above. The liver may be pushed downwards by a right pleuritic effusion, pneumothorax, consolidation of the base of the right lung, and dilatation of the right side of the heart. In all these conditions, except the last, the dullness on percussion over the lower part of the chest may be mistaken for an enlargement upwards of the liver. Rarer conditions may depress the liver, such as various tumours of the mediastinum, a subdiaphragmatic abscess, and also a hydatid cyst, new growths, or abscess of the upper portion of the right lobe of the liver. The left lobe of the liver may be depressed by a large pericardial effusion, or by a left pleural effusion or pneumothorax. The organ is displaced downwards in enteroptosis; in this condition the hepatic dullness is lowered, and sometimes the upper surface of the left lobe may be felt in the epigastric region. In all downward displacements of the liver, the organ does not usually move so well with respiration as when it is in its normal position, or when it is enlarged.

Displacement of the liver upwards occurs usually to a less extent than displacement downwards. It takes place as a result of any condition which increases the pressure within the abdomen, such as tympanites, ascites, pregnancy, and a large abdominal tumour. The liver may be drawn upwards by a rise in the height of the diaphragm due to contraction of the right lung, either as the result of fibrosis or on account of its inability to expand after long compression by a pleuritic effusion which has been removed by absorption or by other means.

The Spleen.

Examination of the Spleen by Inspection.—The spleen must be greatly increased in size before it produces any prominence which can be seen upon inspection of the abdomen. The enlargement of the spleen is chiefly in a downward and forward direction, so that when a prominence becomes visible it is mainly in the left hypochondriac region at first, but extends over to the umbilical region as the organ increases in size. Such a prominence can be seen to move with respiration.

Examination of the Spleen by Palpation—*Method.*—When the spleen is normal in size and position, it cannot be felt upon palpation of the abdomen. The organ is so deeply seated, and lies so far up under the cover of the ribs, that there must be a considerable increase in its size before it projects beyond the costal margin. Although it is necessary for the spleen to be enlarged to a certain degree before it projects from under the cover of the ribs, yet often a feeling of increased resistance may be appreciated by pressing the tips of the fingers up beneath the costal margin. When the spleen is greatly increased in size, it is usually easy to examine by palpation, but when it is not so large it may be very difficult to feel. Two methods of examination by palpation may be employed. The observer stands on the right side of the couch, the patient being in the recumbent position. Pass the right hand round the left side of the patient, and push forward the spleen by pressing with the fingers upon the tenth and eleventh ribs behind;

then place the left hand over the lower ribs in front on the left side, in such a position that the fingers are pointing in the direction of the pubes, and press the fingers into the abdomen, slightly tucking them up under the costal margin. If the patient be directed to take a deep breath, the edge of the spleen when the organ is enlarged may be felt by the fingers of the left hand. This manner of examining the spleen may be used without employing the right hand to push forward the ribs. Another method is to place the examining hand flat upon the abdomen, with the finger-tips depressing the parietes just below the left costal margin. The edge of the enlarged spleen may then be felt upon deep inspiration. This mode of palpation may be aided by placing the other hand behind the patient and pressing forward the spleen as described above. If the enlarged spleen be of firm consistence, it may be easy to feel its lower edge; but if it be soft, then it may be very difficult.

Enlargement of the Spleen.—As the spleen enlarges it projects beneath the costal margin in a downward and forward direction towards the umbilicus. The direction which the spleen assumes as it enlarges is determined by the costo-colic ligament, which supports the organ and prevents it, at first, from passing directly downwards. There is rarely an increase in the upward direction. The spleen enlarges uniformly, as a rule, and retains its original shape. The spleen may become so large as to reach the middle line in front, and even extend beyond it. Any further enlargement usually overcomes the resistance of the costo-colic ligament, and therefore results in an increase downwards, with very little increase to the right, so that the spleen may fill the whole of the left side of the abdomen even down to the pubes.

The anterior edge of the enlarged spleen can usually be well defined upon palpation of the abdomen, and a help in diagnosis lies in the position of this border, which is always directed upwards and to the right. Often one or more notches may be felt in the anterior border. The posterior border of an enlarged spleen can nearly always be defined, as there is a space between it and the erector spinæ muscles on the left side. The most usual conditions which simulate an enlarged spleen are: floating kidney, tumour of the kidney, other new growths in this region, and accumulation of fæces in the splenic flexure of the colon. But if the tumour be superficial, arising from underneath the costal margin, moving with respiration,

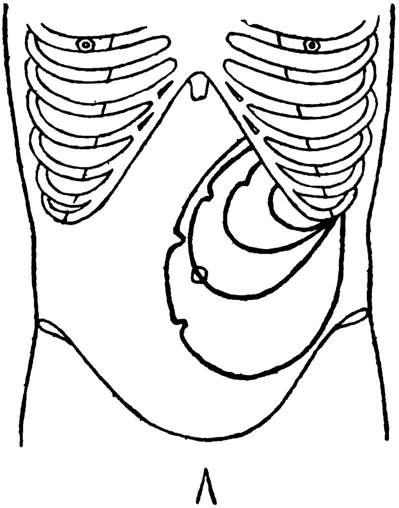

FIG. 22.—ENLARGEMENTS OF THE SPLEEN.

This diagram shows the position the enlarged spleen assumes as it increases in size.

and having smooth and rather sharp edges with a notch in its anterior border, it can be no other organ but the spleen.

Enlargement of the spleen occurs in many diseases: in the specific fevers, especially typhoid fever, also in typhus and scarlet fever; in malaria, leucocythæmia, splenic anæmia, all severe anæmias of children, amyloid disease, Hodgkin's disease, and passive congestion due to portal obstruction or cardiac failure. The largest spleen is found in leucocythæmia, but the organ may be very greatly enlarged in malaria.

The surface of the enlarged spleen is smooth, except in very rare cases, such as hydatid disease or secondary carcinoma of the spleen. The consistence of the spleen varies considerably. In acute diseases, such as typhoid fever, it is soft in the early stages; in septicæmia it is usually very soft; in chronic venous congestion it is much firmer; while in malaria, leucocythæmia, and amyloid disease it is very firm.

Tenderness is not so common over an enlarged spleen as over an enlarged liver. It may occur when there is a recent infarct, in acute venous congestion, and in perisplenitis.

Displacement of the Spleen.—Displacement downwards of the spleen occurs in any condition which lowers the diaphragm. It may therefore be lowered in such conditions as a pleural effusion, pneumothorax, emphysema, or consolidation of the lung on the left side. The spleen may be displaced or dislocated in enteroptosis, and is sometimes found quite a distance from its normal position. In such a condition the size of the tumour, the sharp anterior edge with a notch in it, and absence of splenic dullness in the normal position, indicate that it is a dislocated spleen.

Examination of the Spleen by Percussion.—In order to define the area of splenic dullness, the patient should lie somewhat on his right side, but not entirely on it, as the spleen tends to fall away from the under surface of the ribs. Percussion can be performed with more accurate results when the patient is sitting. It is best to make this examination while the patient is holding his breath at the end of a full expiration; for if it be performed at the end of inspiration or at any other period during inspiration or expiration, the spleen is further away from the chest wall, by the arch of the diaphragm being lower and by more of the left lung intervening. Percussion should be performed very lightly, especially when defining the anterior and lower margins, in order not to bring out the tympanitic note of the stomach and intestines. It may be very difficult to ascertain the area of splenic dullness, as the organ is so easily carried away from the surface. An emphysematous left lung intervening between the spleen and the chest wall, dilatation of the stomach, and tympanites, etc., may make it impossible to define this area.

To define the anterior border of the splenic dullness, light percussion is performed along the tenth rib, commencing near the costal margin, and travelling outwards to the left. The normal position of the anterior margin should be in the mid-axillary line. To define the upper border, deeper percussion is required. Commencing over the left lung behind at the level of the inferior angle of the scapula, half-way between the posterior axillary and scapular lines, percussion is performed vertically downwards. The note over the lung becomes impaired at the upper border of the ninth rib, but absolute or superficial dullness does not commence until the lower margin of the left lung is reached. To define the lower border, percussion is performed in the posterior axillary line, commencing just above the iliac crest, and passing vertically upwards. The lower limit of splenic dullness is found to correspond to the level of the eleventh rib in this line. The position of the posterior border of the spleen cannot be ascertained by percussion, as the dull splenic note blends with the dull note obtained over the erector spinæ muscles.

The splenic dullness is very difficult to obtain when the stomach is distended with gas, as it is almost impossible in this condition to percuss over the spleen without bringing out the tympanitic note originating in the dilated stomach. If the stomach be distended with food, there may be difficulty in distinguishing the dull note elicited over it and that obtained over the spleen. In any condition which produces a dull note upon percussion below the left costal margin, such as ascites, accumulation of fæces, new growth, etc., there is difficulty in demarcating the splenic area. When the spleen is forced upwards by the increased abdominal tension caused by tympanites, large tumours, etc., it is more covered by the left lung, so that the splenic dullness may be diminished or absent. The presence of pulmonary emphysema or gas in the peritoneum may be the reason of the absence of the splenic dullness. In pleuritic effusions, in pneumothorax, and in consolidation of the base of the lung on the left side, it is impossible to define the upper limit of the spleen by percussion.

In order to ascertain whether a patch of dullness above the splenic area is due to an enlargement of the spleen or not, ' it is well to determine the percussion of a line passing from the left axilla downwards and inwards to the umbilicus. This line will necessarily be oblique, and if required it may be curved to carry it outside the areas of cardiac and hepatic dullness, both of which should be defined before attempting the percussion of the spleen. This line will be found more or less resonant throughout. In its upper part pulmonary resonance is obtained, and then, passing across stomach, colon, and small intestines, the differences in the tympanitic note of these organs may be more or less distinctly realized. The presence of such a resonant line removes various sources of fallacy from pleuritic or pericardial effusions, pulmonary condensations, enlargement of the left lobe of the liver, fluid or solid accumulation in the stomach, etc.'*

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* Finlayson, 'Clinical Manual,' 1886.

CHAPTER V

EXAMINATION OF THE KIDNEYS, PANCREAS, PELVIC TUMOURS, ANEURYSM OF THE ABDOMINAL AORTA, ETC.

The Kidneys.

Examination of the Kidneys by Inspection.—Very rarely can any information about the condition of the kidney be obtained from inspection. An enlarged kidney may cause a bulging in the flank, or, if there be a large new growth in connexion with the organ, there may be a prominence of the abdomen; but the morbid conditions which produce any alterations in shape of the abdomen are best examined by palpation and percussion. A perinephritic abscess tends to bulge backwards, and sometimes information may be obtained by placing the patient flat on his face—*i.e.*, in the procumbent posture—and by making inspection from the feet, which shows at once any inequality in the two flanks.

Examination of the Kidneys by Palpation.—When the kidneys are normal in size and in their normal positions, they cannot be felt usually by palpation, except sometimes when the patient is very thin. In such cases only the lower end of the kidney comes in reach of the hand. The method of examining the flanks by palpation has been described already on p. 122, and must always be used in making a physical examination of the kidneys. When the kidney is enlarged or displaced, it can often be felt. On the other hand, no tumour may be felt, although, from the history of the patient and from a careful examination of the urine, there is reason to believe that there is some disease of one of the kidneys, which is associated usually with an enlargement of the organ. In such cases of slight enlargement a tumour may not be felt, but a sense of resistance or fullness may be present; and therefore it is important to determine whether there be any increased resistance or fullness on either side by carefully comparing the two flanks by bimanual palpation. Any tenderness must also be noticed.

When a tumour in the region of the kidney can be felt, it may appear very firm, while in other cases it may have an elastic feel. When the latter condition is present, it is usually due to cystic disease or hydro- or pyo-nephrosis. Such enlargement of the kidneys may be mistaken for an ovarian cyst or a lumbar abscess. In hydronephrosis the tumour varies in size from time to time, and may disappear completely when it has emptied itself. Under these circumstances there is a history that the patient has passed suddenly a much larger quantity of urine than is his custom.

Enlargement of the kidney occurs in hydro- and pyonephrosis, cystic disease, hydatid disease, tuberculosis, carcinoma, and sarcoma. In the last three morbid conditions the tumour is often irregular in shape and nodular on the surface, whereas in the others it is usually oval in shape and smooth. Tumours of the kidney move very slightly with respiration, and this fact helps to distinguish them from tumours of the liver, gall-bladder, and spleen. In cases of suspected renal tumour an examination of the urine must always be made.

A perinephritic abscess, and sometimes inflammatory thickening around the kidney, may be detected by palpation, and in such conditions there is generally some enlargement of the organ, as the inflammatory processes have nearly always originated in it.

Movable Kidney.—The normal kidney moves very slightly with respiration, but under certain circumstances the kidney becomes freely movable. Upon palpation the organ may be felt to slip up and down with the movements of respiration, and often when it has been pushed down during inspiration it can be caught between the two hands and held in this lowered position. In slighter cases of increased mobility the kidney cannot be detained in this way, but slips back during expiration. This is spoken of as a *movable kidney,* and is more frequent in women than men, and on the right side than on the left. Sometimes the patient experiences a sensation of nausea and pain when the movable kidney is examined by palpation. The organ may move even more freely, so that it comes up to the anterior abdominal wall, and can be moved about the abdomen by the examining hands. This is spoken of as a *floating kidney.* In this condition the kidney is attached by two layers of peritoneum to the back of the abdomen like a mesentery.

A movable kidney may be mistaken for a distended gall-bladder, or an elongated portion of the right lobe of the liver, or for a mesenteric tumour. It is distinguishable from the first two of these conditions in that the tumour lies more deeply. A distended gall-bladder appears very near the anterior surface of the abdomen, and moves up and down with respiration, so that it cannot be retained in position by the examining hands, whereas a movable kidney descends during inspiration, and may be retained in the lowered position when expiration occurs. If, however, there be only slight renal mobility, the kidney cannot be detained in this way, but as it is so deeply situated under such circumstances, it cannot be mistaken for an enlarged gall-bladder. A movable kidney, unless there be that great degree of mobility which is associated with the floating kidney, can only very slightly be moved from side to side, whereas a distended gall-bladder can usually be moved in these directions. A deep-seated tumour in one of the flanks, which slips up and down with the movements of respiration, which can be retained by the examining hand during expiration, and which has very little lateral movement, is without doubt a movable kidney.

On the other hand, a floating kidney can very freely be moved about in the abdomen. There can be present all grades of movability of the kidney, and it is in the more freely movable conditions of the organ that mistakes in diagnosis are liable to be made. A floating kidney is recognized by its well-known renal shape and by its size. Its smooth surface and rounded edge are very characteristic. The tumour is freely movable, can often be pushed down towards the pelvis, and can usually be kept in any position by the examining hands during the movements of respiration. In this latter respect it differs from an enlarged gall-bladder. A floating kidney may move about so freely that sometimes there is difficulty in finding it, and in this manner it can be distinguished from the gall-bladder, which, when pushed back from the abdominal wall, always returns, and can be easily felt. When a tumour is thought to be a floating kidney, the loin in which it normally should be situated is often found to be more empty upon palpation than the opposite side.

Tumours of the supra-renal bodies are rare, and usually cannot be distinguished from those of the kidney. A large tumour of the supra-renal gland is exceedingly uncommon, but it is sometimes found in young children, and has the peculiarity that the secondary growths develop very rapidly and assume a great size, often being larger than the original tumour. The secondary growths may occur on the external surface of the skull, and also within the cranium.

Examination of the Kidneys by Percussion.—The kidneys are in such close proximity to solid structures that they can only be defined to a slight extent by percussion. This mode of examination may, however, be performed with the patient lying flat on his face. Percussion should be commenced over the loin, where the tympanitic note of the colon can be obtained, and then carried backwards until the dullness over the kidney is reached. In this manner it may be possible to define the outer or convex border of the kidney. The upper edge of the kidney cannot be determined by percussion on the right side, on account of the liver dullness. On the left side the lower margin of the lung reaches down to the kidney, so that, if percussion be performed close to the vertebral column, the dull note which is obtained below the level of the lung is partly due to the underlying kidney. A little further outwards in the left scapular line the dullness which is obtained occurs over the spleen. In cases of great enlargement of the kidney percussion may help to define the limit of the tumour.

Percussion, however, is of the greatest aid in the diagnosis between renal and other abdominal tumours, for by its means the relation of the colon to the swelling can be determined. The colon lies in front of all renal tumours, so that if there be a swelling in the flank, and there be resonance behind it, the condition cannot be due to any enlargement or tumour of the kidney. Sometimes upon percussion there may be doubt as to whether the colon lies in front of the tumour or not, on account of an accumulation of fæces. Under such circumstances it may be necessary to make a subsequent examination after the bowels have been opened. If there should be any doubt then, the colon may be inflated by means of a rectal tube connected with a Higginson's syringe.

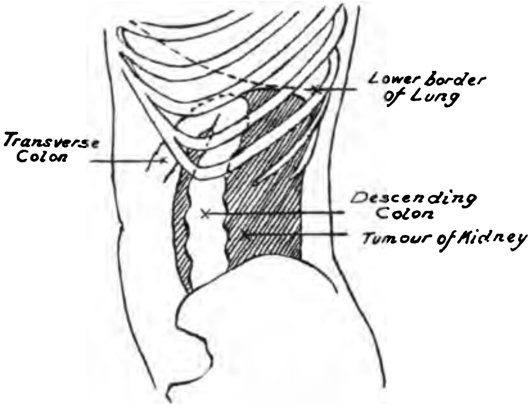

FIG. 23.—TUMOUR OF THE LEFT KIDNEY.

The colon lies in front. The tumour produces dullness in the flank. There is no resonance behind the tumour.

An enlargement of the kidney, therefore, is recognizable by the position of the tumour, by its very slight movement with respiration, and by its position with regard to the colon. The colon always lies in front of a renal enlargement. On the right side the enlarged kidney may be mistaken for a distended gall-bladder, an elongated portion of the right lobe of the liver, a tumour in the right lobe of the liver, a mesenteric tumour, and occasionally a tumour of the head of the pancreas. On the left side a tumour of the kidney may be mistaken for an enlarged spleen. The chief differences between the two are:

Tumour of the Kidney.	*Enlarged Spleen.*
Edge is always rounded.	Edge is usually sharp. One or more notches may be felt on the inner margin.
There is no space between its posterior border and the erector spinæ muscles.	There is always a space between its posterior border and the erector spinæ muscles.
Does not move, or only slightly, with respiration.	Freely movable with respiration.
The colon lies in front, so that there is no resonance behind the tumour.	The spleen lies in front of the colon, so that there is resonance behind the tumour.

The Pancreas.

Diseases of the pancreas can be diagnosed rarely by an examination of the abdomen alone. Other signs usually must be present to draw attention to the organ. Fatty stools may occur owing to incomplete digestion, brought about by the pancreatic juice not being poured out into the duodenum. There may be jaundice, due to obstruction of the common bile-duct, and so the digestion of fat be further disturbed. Fatty stools, however, may be due to other conditions than that of disease of the pancreas. A large quantity of undigested nitrogenous food also may be found in the stools. Diabetes mellitus is an indication of disease of the pancreas. There are also certain examinations of the urine which may be made in suspected disease of the pancreas. Cammidge's reaction may be obtained, but the performance of this requires special skill. Sahli's sign depends upon the recognition of iodine in the saliva or the urine within a certain time after administration by the mouth of 1 grain of iodoform in a glutoid capsule, which is not digested until it comes in contact with the pancreatic juice. If the pancreatic juice enters the duodenum, the iodine reaction should appear in the saliva or urine within six hours.

Acute or subacute hæmorrhagic pancreatitis usually is mistaken for intestinal obstruction, and it is not until the abdomen is opened at a surgical operation that the characteristic areas of fat necrosis or a swelling in the situation of the pancreas show the true nature of the malady.

Nearly all diseases of the pancreas are associated with general emaciation, except hæmorrhagic and gangrenous pancreatitis which occur in patients who are usually fat and in middle life.

Tumours of the pancreas are rare, but may be found upon examination by palpation. They are deeply situated, being covered by the stomach, transverse colon, and coils of small intestines. When a tumour can be felt, it is situated above the umbilicus, lying across the middle line, or just to the right of it when chiefly the head of the pancreas is involved. If the tumour be due to carcinoma it is often nodular and firm, but when due to a cyst it is smooth and elastic. Pulsations of the abdominal aorta are often transmitted by the tumour, so that the swelling may be mistaken for an aneurysm. The pulsations are, however, never expansile. Tumours of the pancreas do not alter their position with the movements of respiration, and they are fixed so firmly that they cannot be moved about in the abdomen. A tumour of the pancreas may be mistaken for one of the stomach, and the differential diagnosis has been given on p. 139. Usually the tumour cannot be felt by palpation unless it be large, on account of it being so deeply situated; but often a sense of increased resistance is experienced, and tenderness may be obtained over the pancreas. In hæmorrhagic and gangrenous pancreatitis the abdomen is usually tumid and distended, and shifting dullness may be found in the flanks, due to the presence of fluid in the peritoneum. It is in these cases of distension that the diagnosis of intestinal obstruction is so often and erroneously made. A tumour of the pancreas may be thought to be one of the colon; but if the colon be inflated through a rectal tube, a tumour of the pancreas partly or completely disappears, while one of the colon becomes more evident.

Pelvic Tumours.

Ovarian, uterine, and other pelvic tumours may be detected upon the examination of the abdomen.

Ovarian cysts have already been described partly on p. 133, where the differential diagnosis between a large ovarian cyst and ascites is given. When the tumour is small it may be felt in one or other iliac regions, and as it enlarges it gradually extends across the abdomen.

Uterine tumours, both physiological and pathological, may be felt above the pubes. The possibility of pregnancy must never be forgotten when a tumour is present which lies in the middle line and appears to arise from the pelvis. Auscultation should be performed, as the uterine souffle or the fœtal heart sounds may be detected (p. 126).

Ovarian and uterine tumours, pelvic cellulitis, pelvic abscess, hæmatocele, diseases of the Fallopian tubes, etc., belong especially to the domain of the gynæcologist and the obstetric physician, and therefore will not be described. The swelling produced by an appendicular abscess may be situated in the pelvis, and can be detected by a rectal examination, which always should be made when disease of the appendix is suspected.

The urinary bladder, when distended, may reach above the pubes, and in great distension up to the level of the umbilicus. It forms a pyriform swelling, lying in the middle line, and obviously extending up from the pelvis. It is often tender upon palpation, and somewhat elastic. On percussion it gives a dull note. Upon the passing of a catheter and the withdrawal of urine the tumour disappears.

Aneurysm of the Abdominal Aorta.

An aneurysm may occur in any part of the abdominal aorta, and also in any of its chief branches, but the only branch in which it is likely to be found is the cœliac axis. Pulsation of the abdominal aorta, especially in the epigastric region, is very commonly felt, but is rarely due to an aneurysm. The swelling formed by an aneurysm is situated deeply and in the course of the aorta, usually making its appearance in the middle line, but sometimes extending more to the left than to the right. The tumour upon palpation gives the feeling of *expansile pulsation*. The expansile character of the pulsations may be determined by compressing the swelling laterally between the fingers; it may be made more obvious by placing the smaller ends of two wooden stethoscopes firmly upon the abdominal wall, one on each side of the tumour, at the same level, when the larger ends of the stethoscopes will be seen to move apart with each pulsation. An aneurysm may be simulated by a tumour lying over the aorta and transmitting its impulses, but in such a condition no expansile pulsation occurs. In many cases the presence of expansile pulsation is easy to determine, while in others it may be very difficult. A thrill is sometimes felt over an abdominal aneurysm, and upon auscultation a murmur may be present which is synchronous with each expansion of the swelling. A murmur, however, may be present without an aneurysm. Pain of a very severe character is usually a marked symptom of an aneurysm of the abdominal aorta.

Some Further Considerations of Tumours of the Abdomen.

It is rare for tumours of the abdominal organs to occupy only the region in which they arise, but it is useful to enumerate those tumours which occur most frequently in each region.

Epigastric Region.—Carcinoma of the stomach, most frequently of the pylorus. Tumours of the pancreas, omentum, and aneurysm of the abdominal aorta. Enlargements, new growths, and displacement downwards of the left lobe of the liver.

Right Hypochondriac Region.—Chiefly enlargements, and new growths of the right lobe of the liver and the gall-bladder. Displacement downwards of the liver.

Left Hypochondriac Region.—Chiefly enlargements, new growths, and dislocations of the spleen. Accumulation of fæces, and new growths in the splenic flexure.

Umbilical Region.—Fæcal accumulations of the transverse colon, aneurysm of the abdominal aorta and its branches. Omental tumours. New growths of the intestines, and enlarged mesenteric glands. Floating kidney.

Right Lumbar Region.—Tumours of the kidney, perinephritic abscess, lumbar abscess, fæcal accumulations.

Left Lumbar Region.—The same as above, but also enlargements of the spleen and tumours of the splenic flexure of the colon.

Hypogastric Region.—Distended urinary bladder, gravid uterus, tumours of the uterus and its appendages.

Right Iliac Region.—Appendicular abscess, diseases of the cæcum, accumulation of fæces, enlarged glands, tumours arising from the pelvic organs, and also tumours arising from the bones of the pelvis.

Left Iliac Region.—Similar tumours from the pelvis. Diseases of the iliac colon, accumulation of fæces, and enlarged glands.

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